Operation, Maintenance, and Monitoring Plan

Pre-Final Design (95% Design)

Remedial Design

Area 9/10

Southeast Rockford Groundwater Contamination Superfund Site

Rockford, Illinois

CERCLIS ID No. ILD981000417

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1.0 INTRODUCTION

This document provides the Operation, Maintenance, and Monitoring (OM&M) Plan for the Remedial Design for Source Control for the Area 9/10 portion of the Southeast Rockford Groundwater Contamination Superfund Site (CERCLIS ID No. ILD981000417) located in the City of Rockford, Winnebago County, Illinois.

Hamilton Sundstrand Corporation (HS) entered into an Administrative Order on Consent (AOC) with the United States Environmental Protection Agency (USEPA) on January 13, 2003 for the completion of a Remedial Design (RD) for source control for Area 9/10. Preparation of the OM&M Plan was specified as part of the February 27, 2003 Statement of Work (SOW) associated with the RD.

The selected remedy for Area 9/10 Remedial Design consists of air sparging and soil vapor extraction to address impacted groundwater (leachate) at the Hamilton Sundstrand Plant # 1 facility within Area 9/10. The remedy is described in the June 11, 2002 Record of Decision (ROD) for Operable Unit Three (OU-3) Source Control. In addition, soil identified as source material at the Outside Container Storage Area (OSA) will be excavated and disposed offsite along with limited groundwater biological enhancement in this location.

1.1 Purpose of Operation, Maintenance, and Monitoring Plan

The purpose of this document is to provide information and procedures to ensure the proper operation and maintenance of the air sparge and soil vapor extraction system installed for the HS Plant # 1 facility within Area 9/10. This OM&M Plan provides a description of each of the remedial system components; electrical requirements and system control; system startup and normal operation; the regular maintenance of activities for each component; system troubleshooting and other processes to respond to operating parameter deviations; safety and security; maintenance; compliance monitoring; reporting frequency; and record keeping. The plan also presents the groundwater monitoring program frequency and reporting schedule.

1.2 Site Description

Area 9/10 (Area) is an industrial area located within the City of Rockford, Winnebago County, Illinois. The Area is bound by Eleventh Street on the east, Twenty-Third Avenue on the north, Harrison Avenue on the south, and Sixth Street on the west. Hamilton Sundstrand Corporation was the only potentially responsible party identified by the Illinois Environmental Protection Agency (IEPA) for Area 9/10. The Hamilton Sundstrand Plant #1 facility (the Site) is located within Area 9/10. The Area 9/10 and HS Site locations are shown on Drawing Y1. The address of the facility is 2421 Eleventh Street. The Site is located in the southeast portion of the City of Rockford, Illinois, in Section 36 of Township 44 north, Range 1 east, of Rockford Township in Winnebago County. The HS Plant # 1 facility within Area 9/10 is a generally rectangular area of approximately 13 acres. The Site is bound on the north by 23rd Avenue and former Mid-States Industrial (2401 Eleventh Street), on the south by the former Nylint/DRB property (2525 Eleventh Street) and the Rockford Products Parking lot, to the west by 9th Street, and on the east by 11th Street. The Site utilities and property boundary for the HS Plant #1 facility are shown on Drawing Y2.

1.3 Site Geology

The geological profile encountered at the HS Plant #1 Facility generally consists of surface pavement (asphalt, concrete pad, or floor slab) with a gravel fill subbase from ground surface to one to two feet below ground surface (bgs), underlain by silty clay to a depth of four to eight feet bgs, which is underlain by poorly to well graded sand (predominantly fine to medium sand) with some gravelly units to below the maximum depth of the borings at the site (140 feet). The sand and gravel has been reported to extend to a depth of 230 to 250 feet bgs in the vicinity of Area 9/10. This glacial outwash is identified as the Mackinaw Member of the Henry Formation. Bedrock encountered in borings/wells in the area is part of the Ordovician period Ancell Group (sandstone) of the Paleozoic era.

The vadose zone extends within the sand to a depth of approximately 30 feet bgs. Within the vadose zone sand there is a discontinuous one to four feet thick silt layer at approximately 18 to 23 feet bgs. This layer was observed only in a limited area in the northwest portion of the Site. No other substantive or continuous fine grained layers or have been documented at the Site. At

depth within the aquifer some coarser grained gravelly sand and sandy gravel units were observed.

The uppermost aquifer at the Site is the sand and gravel aquifer. The potentiometric surface level ranges between 30 to 35 feet bgs. This level varies somewhat seasonally and appears to mirror the general rainfall pattern of the area. Over the past several years the water level has typically been approximately 33 feet bgs. The aquifer is greater than 100 feet in thickness at the Site. The groundwater flow is to the west-southwest at a gradient of approximately 0.0008 ft/ft (0.6 ft / 715 ft in March 2006) toward the Rock River. The hydraulic conductivity of the sand aquifer is 1.22×10^{-3} cm/sec and the aquifer porosity is assumed to be 0.25 (both from the CDM Focused Feasibility Study, 2000). Using this data, it is estimated that the average linear velocity (also referred to as groundwater seepage velocity) is likely between 4 and 10 feet per year.

1.4 Contaminants of Concern

The HS Plant #1 facility was identified as containing soil and groundwater impacted with VOCs above the Preliminary Remediation Goals (PRGs). PRGs were based on 35 IAC Part 620 Groundwater Quality Class I groundwater, 35 IAC Part 742 Tiered Approach to Corrective Action Objectives (TACO), and USEPA maximum contaminant level (MCL) regulations. The compounds detected at concentrations above the PRGs are referred to as constituents of concern (COCs). The soil COCs for Area 9/10 were identified as 1,1-dichloroethene (1,1-DCE); methylene chloride (MC) (possible laboratory artifact); tetrachloroethene (PCE); 1,1,1-trichloroethane (1,1,1 TCA); 1,1,2-trichloroethane (1,1,2 TCA); and trichloroethene (TCE). The groundwater COCs were identified as 1,1-DCE; 1,2-dichloroethane (1,2-DCA); 1,2-dichloroethene (1,2-DCE); ethylbenzene; PCE; 1,1,1 TCA; 1,1,2 TCA; TCE; and vinyl chloride (VC). The facility contains a network of 28 wells to monitor the COC concentrations in groundwater across the site. The monitoring well locations and topography (monitoring well ground surface elevations) are shown on Drawing Y3. The source control remedies for Area 9/10 are air sparge and soil vapor extraction. The extent of the soil and groundwater remediation areas is shown on Drawing Y4.

1.5 Document Overview

This document provides details on the remediation system and groundwater and soil remedy within area 9/10 at the SER Site. Key components of this maintenance and monitoring include:

- Air Sparge System components consisting of sparge wells, well heads, air supply piping, a manifold, and an air compressor are discussed in Section 2 of this document;

- Soil Vapor Extraction system components consisting of extraction wells vacuum conveyance piping, a manifold, an air/water separator, a blower, and vapor treatment are discussed in Section 3 of this document;

- Electrical requirements and system control including telemetry and remote operation are discussed in Section 4 of this document;

- System startup, normal operation, and alarm troubleshooting including system optimization, shutdown procedures, safety, and security are discussed in Section 5 of this document;

- Maintenance for all system components are discussed in Section 6 of this document; and

- Air and groundwater compliance monitoring and barrier inspection including AS/SVE vapor and groundwater monitoring, groundwater management zone monitoring, engineered barrier inspection, and OM&M termination are discussed in Section 7 of this document.

Section 8 provides a discussion of the required reporting and record keeping activities associated with the OM&M of the Remedial Action activities.

2.0 AIR SPARGE SYSTEM COMPONENTS

The air sparge system will include sparge wells, wellheads, air supply piping, manifold, and air compressor. The sections below detail each part of the system.

2.1 Sparge Wells and Wellheads

The air sparge system will consist of 15 sparge wells located in the south alley, south of the HS Plant #1 facility. Drawing Y5 provides the sparge well layout. Each sparge well will be constructed with 1½-inch diameter, 0.010 slot 304 stainless steel (SS) well screen, 304 SS riser, with schedule 40 PVC riser above the water table. The well screens will be two feet long and located at an approximate depth of 52 to 54 feet below ground surface. A filter pack of red flint #3545 (or equivalent) will be placed around the well screen and extended 12 inches above the screen. The annular space surrounding the riser pipe will be filled with bentonite chips hydrated in place for three feet above the filter pack. A bentonite/cement grout (94% cement) will be used to seal the remainder of the annular space. A schematic of the sparge well construction is provided in Drawing Y6.

Each air sparge well will be contained in a locking traffic rated well box. The bottom of the well box will be backfilled with pea gravel to provide adequate drainage. The pressurized air supply line will enter the well box vertically from the bottom and turn 90 degrees toward the well. The pressurized air supply line will connect to the sparge well by a PVC tee welded to the riser. The air supply line will be fitted with a flanged connection and ball valve prior to connecting to the well. The top of the well riser will be sealed and fitted with a liquid filled pressure gauge and sampling port.

The 15 air sparge wells will be divided into three banks of five wells. Each of the three banks will act as an independent treatment cell; Treatment Cell #1, Treatment Cell #2, and Treatment Cell #3. The treatment cells will operate successively utilizing a timing relay and air solenoid valves. Each treatment cell will be pulsed for a set time. The pulse time will be adjustable and determined by the system removal rates. Initially, the timers will be set to operate the sparge wells in one treatment cell for four hours followed by an hour delay before cycling to the next treatment cell. Drawing Y5 identifies the treatment cell locations.

2.2 Air Supply Piping

The below grade air supply piping to the sparge wells will be 1½-inch SDR-11 HDPE. Each sparge well will be individually plumbed with separate air supply lines. The air conveyance piping will be buried 42 inches below ground surface. The piping will be laid on six inches of clean sand pipe bedding and covered with six-inches of sand. Warning tape and tracer wire will be placed above the pipe in the trenches prior to backfilling.

2.3 Manifold

The manifold for the sparge system will be located inside the water tank building. The pressurized air supply lines for each well (15 lines total) will enter the water tank building through the floor on the north wall and transition from HDPE to 1½-inch Schedule 40 galvanized steel. The air sparge system manifold is divided into three banks of five wells each. The main header line of the manifold is constructed of 2-inch Schedule 40 galvanized steel. The manifold includes the following:

- Union;
- Liquid filled 0-30 psi pressure gauge;
- 4-20 mA pressure sensor;
- Rotometer (Dwyer Model UV-C112);
- 4-20 mA differential pressure sensor;
- Brass ball valve; and
- Brass gate valve.

Drawing M2 shows the manifold detail. The equipment manuals for both the rotometer and solenoid valve are provided in Appendix A.

2.4 Air Compressor

The air delivery component of the sparge system will be a 15-Hp rotary vane compressor (Reitschle Model DTB (06) 180 MACRO). The air compressor will be dry running (non-lubricated) with low maintenance requirements. The equipment manual for the air compressor is provided in Appendix A.

The air supply line coming off of the compressor discharge will be equipped with the following:

- Pressure relief valve;
- High/low pressure switch;
- Actuated regulator valve;
- Flow meter;
- 4-20 mA differential pressure sensor;
- Temperature gauge;
- 4-20 mA temperature sensor;
- Liquid filled pressure gauge;
- Ball valve; and
- Bleed valve.

The pressure relief valve is a safety mechanism. The valve opens at a preset pressure of 30 psi to avoid over pressurizing the sparge wells. The pressure switch will shut down the system in the event of a high or low pressure condition. The actuated regulator valve adjusts the air flow and pressure from the air compressor. The actuated valve allows for remote control of the air sparge flow rate. The flow meter is an averaging pitot tube that monitors the total air flow from the compressor. The 4-20 mA differential pressure sensor is used to monitor velocity pressure and static pressure in the discharge line by sending a signal to the control panel/PLC. The 4-20 mA signal from the differential pressure sensor is also used to calculate the total flow rate from the compressor and to detect zero flow conditions at the compressor discharge (discussed in Section 5.6.3). The temperature gauge monitors the temperature of the air to the sparge wells. The 4-20 mA temperature sensor sends a signal to the control panel that allows the temperature data to be accessed remotely. The liquid filled pressure gauge monitors the overall air pressure in the supply lines. The ball valve can isolate flow from the manifold. The bleed valve is used to reduce air flow and air pressure. A piping and instrumentation legend and diagram are provided as Drawings P1 and P2, respectfully.

3.0 SOIL VAPOR EXTRACTION SYSTEM COMPONENTS

The SVE system will include extraction wells, vacuum conveyance piping, a manifold, an air/water separator, a blower, and vapor phase granular activated carbon (GAC). The sections below detail each part of the SVE system.

3.1 Extraction Wells

The SVE system will include six extraction wells. The extraction wells will be constructed with a 10 feet section of 4-inch diameter, 0.010 slot PVC well screen connected to 4-inch diameter PVC riser. The depth to groundwater in the treatment area is typically 33 feet bgs. The screened interval of the extraction wells will be approximately three feet above the average water table level to reduce the effect of groundwater mounding and potential masking of the extraction well screen. The filter pack around the screen will be red flint #3545 filter sand pack (or equivalent) and extend 12 inches above the screened interval. A 12-inch sugar sand filter collar will be placed above the filter pack. The SVE wells will be sealed using bentonite chips hydrated in place. The bentonite seal will extend three feet above the filter collar. Bentonite/cement grout (94% cement) will be used to fill the remaining annular space.

A PVC Tee will be welded to the riser and connected to the extraction line. A ball valve will be placed in line to regulate flow from the extraction well. The well head will have a liquid filled vacuum gauge and sampling/monitoring port. Construction diagrams for the SVE wells and well vaults are provided on Drawings Y6 and M2, respectively.

The six extraction wells will be divided into three banks of two wells. Each of the three banks will act as an independent treatment cell; Treatment Cell #1, Treatment Cell #2, and Treatment Cell #3. The treatment cells for the SVE wells will correspond with the air sparge well treatment cells discussed in Section 2.1. The treatment cells consisting of both the AS and SVE components will operate sequentially utilizing a timing relay and air solenoid valves. Each cell will be pulsed for a set time. The pulse time will be adjustable and determined by the system removal rates. Initially, the timers will be set to operate the SVE wells in one treatment cell for five hours before cycling to the next treatment cell. Drawing Y5 identifies the treatment cell locations.

3.2 Vacuum Piping

The SVE vacuum conveyance piping will be constructed of two-inch SDR 11 HDPE piping. The vacuum piping will be buried at a depth of 42 inches or deeper. The piping will be laid on six inches of clean sand pipe bedding and covered with six inches of sand. Warning tape and tracer wire will be placed above the pipe in the trenches prior to backfilling.

3.3 Manifold

The manifold for the SVE system will be located inside the water tank building. The vacuum lines for each extraction well (six lines total) will enter the water tank building through the floor on the north wall and transition from HDPE to two-inch Schedule 40 PVC. The SVE system manual is divided into three banks of two vacuum lines each. The three banks are connected to a main header line constructed of 3-inch schedule 40 PVC. The manifold includes the following:

- Union;
- Clear sight tube;
- Self averaging pitot tube with magnahelic gauge;
- 4-20 mA differential pressure sensor;
- Liquid filled 0-80 inches H_2O vacuum gauge;
- 4-20 mA vacuum sensor;
- Brass ball valve;
- PVC gate valve; and
- Timer controlled solenoid valve.

Drawing M2 shows the as-built manifold detail. The equipment manuals for both the pitot tube and solenoid valve are provided in Appendix A.

3.4 Air/Water Separator

The main vacuum extraction manifold will be connected to the air/water separator tank for removal of entrained water or condensate. The separator will be equipped with automatic level controls and flapper valve to remove collected water from the unit once a certain level is reached. When the high level in the tank is reached, the SVE and AS blowers will be turned off,

the flapper valve will open and the recovered water will drain to an air sparge well. The equipment manual for the air/water separator is provided in Appendix A.

3.5 Blower

The SVE blower will be a Reitschle Bora Regenerative Side Channel Blower Model SAP 380 with a 6.4 hp motor. The blower will be capable of delivering 200 acfm at 60 inches H_2O. The equipment manual for the blower is provided in Appendix A. The vacuum line going into the blower will be equipped with:

- A vacuum relief valve;
- A liquid filled vacuum gauge;
- A ball valve;
- An actuated make up air valve;
- A 4-20 mA differential vacuum sensor; and
- A 4-20 mA vacuum sensor.

The vacuum relief valve will be a mechanical valve that opens at 100 inches of H_2O to avoid high vacuum conditions and potentially damaging the blower. The liquid filled pressure gauge will monitor vacuum pressure at the blower influent. The ball valve will regulate flow to the manifold. The actuated make up air valve will supply ambient air to provide additional air to the blower and reduce vacuum at the manifold. The actuated make up air valve can be controlled remotely. The 4-20 mA differential vacuum sensor will be used to monitor velocity and static pressure in the influent vacuum line of the blower. The 4-20 mA signal from the differential vacuum sensor will also be used to calculate the total flow rate from the compressor and to detect zero flow conditions at the blower inlet (discussed in Section 5.6.3).

The discharge (pressure) side of the blower will contain:

- A self averaging pitot tube;
- A temperature gauge; and
- 4-20 mA temperature sensor.

The flow meter will be an averaging pitot type flow meter that monitors total air flow from the vacuum blower effluent. The temperature gauge will be used to monitor the temperature of the

vacuum blower effluent. The 4-20 mA temperature sensor will send a signal to the control panel that allows the blower discharge temperature to be accessed remotely.

3.6 Vapor Treatment

The vacuum blower effluent will be connected to a vapor phase treatment system. The vapor phase treatment system will consist of two granular activated carbon (GAC) units, a primary and secondary unit, plumbed in series. The secondary carbon unit will act as a back up in the event VOC breakthrough occurs at the primary unit. Each unit will be a Carbonair GPC 20R containing 2,000 pounds (lbs) of GAC (or equivilant) designed for vapor phase adsorption. Equipment manuals for the GAC vessels are provided in Appendix A. The carbon units will be connected with flexible hose and quick disconnect fittings to facilitate carbon change out and removal. Air discharge sampling ports will be located between the carbon units and at the discharge. There is also an air discharge bypass prior to entering the GAC for direct discharges to the atmosphere which may be used if concentrations of VOCs are below 8 lbs per hour. When breakthrough in the primary unit is detected, the secondary unit will become the primary unit and the new unit (or regenerated GAC unit) will become the new secondary unit.

4.0 ELECTRICAL REQUIREMENTS AND SYSTEM CONTROL

4.1 Electrical Requirements

The electrical distribution system will be a 230 volt, 200 amp, three phase, 60 Hertz service provided by the facility through a fusible disconnect. A breaker panel will provide 230 volt, three-phase power to the major electrical components of the system. An additional breaker panel provides 230/120 volt, single-phase power for auxiliary and control systems. The AS compressor, SVE blower, and control panel box will have the appropriate National Electrical Manufacturers Association (NEMA) ratings in accordance with local building codes and ordinances. The electrical symbols legend used are shown on Drawing E1. An electrical one-line diagram of the remediation system is provided as Drawing E2.

4.2 System Controls

The system has been designed to operate up to 24 hours per day, 365 days per year, without supervision. The AS/SVE system equipment and sensors will be connected to a control panel/programmable logic controller (PLC). The control panel will allow for the automatic or manual operation of the blower and compressor with hand-off-auto switches. The manual operation will be used during system start up, troubleshooting, and on an as-desired basis.

Solenoid valves located on the AS and SVE manifolds will be opened and closed based on timer settings for the operation of the three treatment cells. The timers will be adjustable and cycle times determined by the system removal rates.

The air/water separator unit will be equipped with high level, low level, and high-high-level stainless steel conductivity probes as well as a high level float switch. A timer relay will be activated when the extracted water level in the air/water separator reaches the high-level conductivity probe. The timer relay will turn off the SVE blower and the AS blower for 10 minutes. With the reduction in vacuum, the flapper valve at the bottom of the vessel will open and the water in the vessel gravity will drain to an air sparge well. At the end of the timer sequence, the AS/SVE system will restart and normal operations will commence. If the high-high level conductivity probe or the high level float switch is contacted, the SVE blower and sparge compressor will be shut down.

An air pressure switch will be installed in the air compressor discharge line. The pressure switch will monitor the discharge pressure from the air sparge blower. The switch will be set for a low pressure condition (5 psi) and a high pressure condition (30 psi). In the event that the maximum air pressure is exceeded or the minimum air pressure is not met, the compressor will be shut down. The pressure switch controls will include a timer that is used to eliminate the effects of transient pressure conditions. The system will shut down only if the maximum or minimum pressure condition is maintained throughout the entire programmed timed interval. For example a high air pressure condition must be maintained for the duration of the timed interval (usually 30 seconds) to trigger the high pressure alarm. The pressure switch will not be active while the sparge system is switching between treatment cells.

A mechanical, spring operated, high vacuum pressure relief valve will be located at the influent of the SVE vacuum blower. The vacuum relief valve will be adjustable. In the event the blower vacuum exceeds the relief valve preset maximum condition requirement, the valve will open to the atmosphere reducing the vacuum and increasing the air flow to the blower. The vacuum relief valve is monitored by the telemetry unit and an alert message will be sent when the relief valve is opened.

4.3 Telemetry and Remote Operation

The AS/SVE control panel will be equipped with a telemetry system which will provide notification of any system alarm condition and/or system shut down. In the event of an alert or alarm condition, the telemetry system will allow remote system restart. The telemetry also allows the system to be shut down remotely. In addition to shut down and restart capabilities, the telemetry system will supply outputs for various operational data in the treatment system and allow for some remote operation of the system. Table 1 identifies the outputs available, the sensor locations, and the remote capabilities.

5.0 SYSTEM STARTUP, NORMAL OPERATION, AND ALARM TROUBLESHOOTING

5.1 System Startup

At system startup, the sparge wells and extraction wells in Treatment Cell #1 are to be placed in operating mode (valves at wellheads and manifold open). The wells in Treatment Cells #2 and #3 are to remain off (valves are wellheads and manifold closed) until the operation at Treatment Cell #1 is confirmed. The SVE system in Treatment Cell #1 will start prior to the sparge system in order to ensure vapor buildup down not occur and to minimize the potential for any effect on the indoor air of the plant building. The SVE system can be started independently of the AS system by placing the SVE blower switch to the "hand" position on the control panel.

The design vacuum and flow rate for each SVE extraction well is approximately 30 inches H_2O and 100 scfm. The gate valves at the SVE wellhead and manifold will be adjusted if wide fluctuations from the design flow rate are observed (i.e. greater than 30 percent of the average). It is common to observe some flow variance between the individual wells due to natural heterogeneities in the soils. The SVE system is to operate in this mode until a steady state recovery of airflow is observed.

Once steady state recovery has been observed, startup of the sparge system will proceed. The AS system will be started by placing the compressor switch on the control panel to the "hand" position. The minimum design injection pressure for the sparge wells is 9.52 psi and a flow rate 20 scfm per well. The injection pressure and flow rate should be monitored and adjusted according to the design parameters. The total air flow rate extracted by the SVE blower should be greater than the total air flow rate injected by the air sparge compressor. Air monitoring with a PID of the surrounding area, including inside the plant building, will be completed during the initial startup of the sparge system as a precautionary measure.

After the operation of Treatment Cell #1 has been confirmed, the startup procedures will be repeated for Treatment Cells #2 and #3. After the operation of all three cells has been confirmed separately, the system will be placed into automatic mode to confirm the timers are cycling properly and each treatment cell is operating as designed.

5.2 Startup VOC Extraction Rates

After the startup of the system, baseline samples of the VOC extraction rates of each SVE well will be collected. Extraction flow rates and vacuum levels for each extraction well will be recorded from the self averaging pitot tubes and vacuum gauges on the SVE manifold. These values will be compared to the values sent to the control panel by the 4-20 mA sensors to confirm that the sensors are working properly.

Baseline VOC samples will be collected in Tedlar bags from each of the extraction wells. The VOC concentrations from each sample will be measured on site using an 11.7 eV Photo-ionization Detector (PID) (or equivalent). The samples will be collected using a vacuum pump connected via flexible tubing to the sample port fittings. The sampling pump effluent will be connected to the Tedlar bag. When the Tedlar bag is full, the stopcock valve will be used to seal the bag. A portable PID hand-held unit will be used to measure the concentration of VOCs in each extracted air sample.

5.3 System Optimization

The data collected from monitoring the VOC extraction rates at the individual wells will be used to optimize the performance of the system. This will be accomplished by adjusting the extraction airflows so they are proportional to the extracted VOC concentrations. The airflow from extraction wells that exhibit very low VOC concentrations may be reduced by partially closing the valve to the well, so that higher volumes can be extracted from wells with greater VOC concentrations.

5.4 Startup Monitoring

After the initial startup adjustments have been made to the system, the system will run under the supervision of the operator. The operator will monitor system vacuum levels and injection pressures to assure that excessive vacuum or pressures do not build up in the subsurface treatment zone. If substantial vacuum increases are observed, the operator will increase the flow rates to the air sparge wells or open the make up air valve. Conversely, if substantial

subsurface pressure is observed, the air sparge well flow rates will be decreased or the make up air valve will be closed.

5.5 Normal System Operation

When the startup period is completed, the treatment system will be placed into a continuous operations mode. Each treatment cell will be operated separately by the PLC controller. Compressed air will be supplied to AS wells in Treatment Cell #1 for a period of four hours. After four hours, the air supply to the AS wells in Treatment Cell #1 will be shut off for one hour. The SVE wells in Treatment Cell #1 will operate for the entire five hours. After Treatment Cell #1 operates for five hours, the cycle will begin again with Treatment Cell #2. After Treatment Cell #2 runs for five hours, the cycle will begin with Treatment Cell #3. The normal operation period will change over time from the initial schedule and will evolve to be periodic operation.

During normal operation, routine preventive maintenance will be performed during the monthly monitoring visits in accordance with the established maintenance schedules documented in Table 2 (and further described in Section 6.0). The system vapor concentrations, vacuum and water levels, and groundwater compliance monitoring will be performed based on the schedules provided in Tables 3 through 5, respectively (and further described in Section 7.0). The operator is required to shutdown and restart the system to perform system maintenance. The procedures for startup and shutdown of the treatment system for maintenance are outlined below.

5.5.1 System Startup Procedures

- Visually inspect the system to ensure all piping and equipment is intact and in operating condition;
- Close or check that the main electrical disconnect to the system is closed;
- Close or check that all electrical breakers to control systems are closed;
- Ensure power is supplied to control panel;
- Check that all valves are properly aligned;
- Close or check that local disconnect to the blower and compressor is closed;
- Reset the system at the control panel;
- Turn switches to auto on the control panel; and

- Check that equipment starts and functions correctly.

5.5.2 Continuous System Operation and Optimization

In order for the treatment system to operate effectively during continuous system operations, operational manipulations will be required on an ongoing basis. Large adjustments to airflow from the air sparge and extraction well may be done as appropriate, based on the results of the vapor sampling of each extraction well, as instructed by the engineer. It is the engineer's responsibility to determine which wells should maintain higher flow rates, which should maintain lower flow rates, and which should be shut off completely. Adjustments to the cycle timers that control the cycle time of each treatment cell will also be made as appropriate, as instructed by the engineer. Once the engineer has determined the optimal flow rates from each well and timer settings, it is the responsibility of the field personnel to set the timers, set extraction well flow rates, monitor/maintain the appropriate vacuum level and flow rate for each SVE well, monitor/maintain the appropriate injection pressure and flow rate to each AS well, and report any unusual fluctuations. Any adjustments made to the timers or airflow from the extraction wells will be recorded by the field personnel on the monthly operation and maintenance checklist provided in Appendix B.

5.6 Troubleshooting Alarm Conditions

Following are alarm conditions which will initiate a system shutdown and likely causes:

- Low or high pressure in the air compressor discharge line
- Low or high vacuum in the SVE blower influent line
- Zero flow at SVE blower or AS compressor
- High level in the air/water separator tank
- High temperature at the blower discharge
- High temperature at the compressor discharge
- Electrical failure
- High amperage at the blower or compressor

5.6.1 Troubleshooting Low or High Pressure in the Air Sparge Manifold Alarm Condition

Low pressure in the air sparge manifold could occur if a leak developed in the air sparge piping. High pressure in the air sparge manifold could occur if a blockage developed in the sparge piping. If a low or high pressure occurs, the system controls will shut down the air

compressor. Low or high pressure in the sparge manifold can be manually or remotely reset.

5.6.2 Troubleshooting Low or High Vacuum in SVE Blower Influent Line Alarm Condition

Low vacuum on the influent line to the SVE blower could occur if a leak developed in the influent piping or the make up air valve was open too far. High vacuum on the influent line could occur if there was a blockage in the piping or if the make up air valve was not open enough. If a low or high vacuum level occurs in the SVE influent line, the blower would be shut down. The make up air valve can be adjusted manually or remotely and the low/high vacuum alarm can be reset manually or remotely.

5.6.3 Troubleshooting Zero Flow at SVE Blower or AS Compressor Alarm Condition

Zero flow at the SVE blower or AS compressor will occur if the blower or compressor shut down for any alarm condition, electrical failure, or mechanical failure. If zero flow is detected in the SVE blower discharge, the air compressor will be shut down immediately. If zero flow is detected in the air compressor discharge, the SVE blower will be shut down after a timer delay. The zero flow alarm can be reset manually or remotely.

5.6.4 Troubleshooting High Level in Air/Water Separator Tank Alarm Condition

A high level in the separator tank could occur if the SVE blower and air compressor do not turn off when the tank reaches the high level or if the separator flapper valve does not open correctly to allow the discharge of the collected water. If a high level alarm occurs at the primary separator tank, the system control panel shuts down the vacuum extraction blower and air sparge compressor. The high level alarm requires a manual reset so that the controls and flapper valve can be inspected prior to restarting the system.

5.6.5 Troubleshooting High Temperature at Blower Discharge Alarm Condition

High temperature at the blower discharge occurs if the blower is not receiving enough air to cool the motor. High temperature at the blower discharge disables the blower. The alarm can be reset manually or remotely.

5.6.6 Troubleshooting High Temperature at the Air Compressor Alarm Condition

High temperature at the air compressor occurs if the there is not adequate air circulation around the compressor to cool the motor. High temperature at the compressor disables the compressor. The alarm can be reset manually or remotely.

5.6.7 Troubleshooting Electrical Failure Alarm Condition

Electrical failure can occur as a result of a power outage or power surge. In the event of a power outage, the remedial system restarts itself when power is restored. The blower has a 2-second delay-on-operate to prevent restart during a power surge.

5.6.8 Troubleshooting High Amperage at the Blower or Compressor Alarm Condition

High amperage at the blower or compressor may occur if an object became lodged in the lobes of the blower or in the motor of the blower or compressor. The high amperage alarm disables the blower or compressor. The alarm can be reset manually or remotely.

5.7 Action If Cleanup Standards are Exceeded

If the emissions from the SVE system are elevated, the air dilution value on the blower may be adjusted to allow additional ambient air into the process stream as long as adequate vacuum is maintained to recover the AS injected air. Resampling of emissions may also be performed to confirm anomalous analytical data.

If groundwater monitoring results are above the PRGs at levels that indicate the system effectiveness may be of concern, a detailed evaluation of the ROI, vacuum, and groundwater geochemical parameter may be performed to determine necessary adjustments to the system operation.

5.8 Safety and Security Considerations for O&M

Following are several safety and security items to be implemented:

- Prior to completing maintenance activities, the AS/SVE system shall be turned off at the control panel. This will ensure that the potential for remote or automatic restarting of the system will not occur.
- If odors are present within the remediation system portion of the water tank building, a PID will be used to evaluate the atmospheric conditions and guide appropriate use of personal protective equipment.
- The remediation system will be kept in a clean and organized manner at all times.
- Only a qualified electrician will make any changes, modifications, or electrical system evaluations of the control panel and wiring.
- The remediation system portion of the water tank building will be locked with limited distribution of door keys to minimize access of non-trained personnel.

The Amended Health and Safety Plan provides additional guidance for safe facility operations.

5.9 System Shutdown Procedures

The following are the system shutdown procedures to be followed:

- Turn switches to OFF on the Control Panel.
- Shut valves and open disconnects as necessary.

5.10 Final Shutdown

The system will continue to operate initially until VOC extraction rates reach asymptotic conditions, or until operation of the system provides limited removal of the constituents of concern (COC) remaining in the treatment zone. When this occurs, the system will be pulsed intermittently until the system again provides limited removal of COCs from the treatment zone. Final shut down will be initiated based on system performance, the soil vapor and groundwater analytical results, and justification for monitored natural attenuation as the last phase of the remediation treatment pipeline.

6.0 MAINTENANCE

The AS and SVE systems are designed to run continuously without supervision. A maintenance schedule is required in order to ensure all the equipment is functioning correctly and properly maintained. Maintenance performed on the AS/SVE system and components shall be recorded on the Monthly Operation and Maintenance Checklist form. The completed forms shall be placed chronologically in Appendix C of the SECOR office copy of this document. Table 2 outlines the regular maintenance inspection schedule for the treatment system. This Section provides a detailed account of all maintenance performed and provides vital information for troubleshooting in the event of a system failure. Before performing maintenance on the system, the operator should review the completed maintenance forms and relevant equipment maintenance manuals. The maintenance requirements for the system are described below.

6.1 Extraction and Sparge Wells

The extraction and sparge wells shall be inspected monthly to ensure no damage has occurred. The following should be of note during the inspection:

- Casing integrity;
- Surface seal integrity;
- Cover airtight seal integrity;
- Wellhead component integrity (valves, gauges, etc.);
- Sediment accumulation within the wells; and
- Well box integrity.

6.2 Air/Water Separator

The air water separator shall be inspected monthly for solids or sludge build up. The flapper valve should be inspected for proper operation. The level probes should be inspected for scaling or buildup. If required the tank, flapper valve, and/or level probes should be cleaned.

6.3 Piping and Fittings

The accessible piping and fittings shall be inspected during each maintenance visit for leaks and damage. If any abnormalities are found they should be reported and a plan of action determined for repair or replacement.

6.4 Compressor

The compressor shall be maintained in accordance with the operating manual provided by the manufacturer which is included in Appendix A.

6.5 Blower

The blower shall be maintained in accordance with the operating manual provided by the manufacturer which is included in Appendix A.

6.6 GAC Change Outs

The GAC is replaced in the primary vapor phase unit when the effluent sample of the primary unit becomes detectable. The secondary unit at this time is shifted to be the new primary unit and a new GAC will go in as the secondary unit. The spent GAC is to be shipped as a listed waste to a disposal or regeneration facility via licensed hazardous material truck.

6.7 Emergency Maintenance

In the event that the system ceases to operate in the designed manner, efforts shall be focused on returning the system to operation as soon as possible. The maintenance records shall be reviewed to help identify possible causes of the system problem and how to alleviate problems in the future. A maintenance record form shall be filled out identifying the cause of the system failure and recommendations of what can be done to prevent recurrence.

6.8 Spare Parts

Most of the components for the remediation system have a minimum life span of five years or greater. Replacement of system parts or components is therefore anticipated to be minimal. The only essential items required on Site at all times are blower inlet filters and compressor discharge filters.

7.0 AIR AND GROUNDWATER COMPLIANCE MONITORING AND BARRIER INSPECTION

Periodic sampling of the recovered vapor and site groundwater is required to confirm the effectiveness of the treatment system operation and environmental compliance. The sampling requirements are summarized in detail below.

7.1 AS/SVE System Vapor Sampling

Baseline air samples will be collected at each of the treatment cells during initial startup. These samples will be analyzed by USEPA Method TO-14 for VOCs. The list of VOCs to be recorded by the USEPA TO-14 analysis is presented in Table 6. After the startup procedures for the system have been completed, vapor samples will be collected from sample ports located before the primary carbon vessel, after the primary carbon vessel, and after the secondary carbon vessel. These samples will be collected on a daily basis for the first week of the GAC system operations. The GAC system sample monitoring will be performed with a PID. After the first week of operation, vapor samples associated with GAC will be collected on a weekly basis for a period of up to five additional weeks. Air emission and/or GAC system monitoring will be completed on a monthly basis thereafter. The air emission vapor samples will be analyzed for VOCs by USEPA Method TO-14.

Vapor samples will be collected from the six SVE wells after start up and on a quarterly basis (at a minimum) in order to optimize system operations and evaluate the progress of the system. Each vapor sample will be analyzed for VOCs with a PID or by USEPA Method TO-14. The sampling frequency for the vapor monitoring points during the initial system startup and normal operation is summarized in Table 3. Additional soil vapor sampling or monitoring may be completed from individual wells.

7.2 AS/SVE System Groundwater Monitoring

Groundwater monitoring for the AS/SVE system includes the collection of vacuum measurements, water level measurements, and groundwater sampling of wells in the vicinity of the treatment zone. Water levels and vacuum measurements will be collected from monitoring wells in or near the treatment zone that are screened across the water table daily for the first

week, weekly for the next five weeks of operation, and on a monthly or as needed basis thereafter around the active treatment cells. The system performance monitoring wells include SMW-20, SMW-21, GMZ-2, GMW-3, and GMZ-4. Additional wells that will be monitored initially include: SMW-4, SMW-5, SMW-6, SMW-7, SMW-8, SMW-15, SMW-22, and MW-201. Vacuum measurements will be taken by connecting magnahelic gauges to the hose barb on the wellhead with tubing and opening the valve. Table 4 summarizes the vacuum and water level monitoring and frequency during start up and normal operation. Baseline groundwater sampling will be performed at monitoring wells in the vacuum or the AS/SVE system and periodically after startup. The list of wells and sampling frequency is provided in Table 5.

7.3 Groundwater Management Zone Monitoring

The GMZ monitoring network which consists of eleven wells (GMZ-1 through GMZ-4, SMW-1, SMW-2, MW-7FGA, SMW-19, SWM-20, SWM-21, and MW203) will be monitored on a periodic basis for VOCs and natural attenuation parameters. The GMZ monitoring well network and screen depths are shown on Drawing D8. Groundwater samples will be collected on a quarterly basis for the first year of the remedial action. Water level gauging will also be completed quarterly for this period. Thereafter, based on the performance monitoring results, the monitoring frequency may be reduced to semiannually or annually. The list of VOC parameters to be reported by USEPA Method 8260B is provided in Table 7. The natural attenuation monitoring parameters and analytical methods to be used to evaluate the performance of the HRC-X® placement and the overall attenuation activity within the aquifer at the site are provided in Table 8.

7.4 Engineered Barrier Inspection

Periodic inspection and verification of the condition of surface barriers will be performed for those designated as institutional controls. An inspection will be completed every five years (minimum). A site inspection form will be completed which identifies the satisfactory condition of the barrier or specifies required maintenance to be performed. The inspection will include identification of breaches in the barrier, cracks, notations on the structural integrity of the surface, necessary erosion control, and other factors as necessary. The inspection will be completed by a Licensed Professional Engineer in the State of Illinois or other responsible professional (as appropriate).

The locations of engineered barrier(s) implemented as institutional controls will be added to this plan as Drawing D9. The location, horizontal limits (in state plane coordinates), surface material, and a cross section of the as built construction will be included on the drawing.

7.5 O&M Termination

When the AS and SVE system data, supported by groundwater analytical data, indicate that termination of operation and maintenance of the system is technically justified, a report summarizing this data will be prepared and submitted to USEPA for approval. This report will identify what additional actions are proposed to achieve the necessary results for preparation of a final close out request.

8.0 REPORTING AND RECORDKEEPING

8.1 Reporting

A System Performance Report will be submitted to USEPA on a quarterly basis for the first year after normal operation begins. The report will be submitted by the end of the following quarter following the operating period. Thereafter, system performance reports will be prepared and submitted to USEPA annually or another agreed upon schedule. The System Performance Report will assess the following performance measures to determine if the system is operating successfully:

- Water levels in the treatment area - Is there sufficient influence in the treatment area to affect contaminant recovery from soils and groundwater?
- VOCs removed in the vapor phase - Is the system able to maintain the expected air flow from the soil formation? Are the vapors removed by the system high in contaminant concentrations? Are the concentrations of the contaminant remaining constant or decreasing over time?
- VOCs stripped from the groundwater - Is the sparge system affecting contaminant concentrations in the groundwater? Are the contaminant concentrations remaining constant or decreasing over time?
- Vacuum Propagation - Is the system able to maintain the expected vacuum based on pilot test information? Is the radius of influence for the extraction wells similar to or greater than the design basis? Is short circuiting a problem?
- Stabilization of the Treatment Area - Is the system limiting VOC migration? Are the contaminant concentrations in surrounding monitoring wells changing?
- Operational runtime and key maintenance activity.
- Engineered barrier inspection and summary (as appropriate).

The System Performance Report will include the following figures and tables to demonstrate the above performance measures are being achieved:

- Static water level potentiometric surface maps throughout the treatment zone, to indicate the influence achieved by the system;
- Vacuum isobar maps to indicate vacuum levels radii of influence achieved by the system;

- Summary tables of analytical results detailing the quantities of each contaminant of concern (and total VOCs) removed in the vapor over time;
- Summary tables of groundwater sample analytical data;
- Site maps showing the analytical results of each groundwater sampling event at all relevant monitoring wells.

If USEPA requires additional periodic system progress reports prior to the submittal to the System Performance report, USEPA and HS will determine the frequency of their submittal.

8.2 Recordkeeping

The OM&M system periodic monitoring sheets, system inspection forms, maintenance logs, engineered barrier inspection forms, and performance reports will be retained for a period of ten years or as required by other legal requirements.

TABLES

Table 1
Telemetry Outputs and Remote Capabilities
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

SECOR

Output	Sensor	Location	Remote Operation Capabilities
SVE Blower Vacuum (in H_2O)	4-20 mA Vacuum Sensor	Blower Influent Vacuum Line	Make up air valve can be adjusted to increase or decrease vacuum level
Compressor Discharge Pressure (psi)	4-20 mA Pressure Sensor	Compressor Discharge Line	Discharge line regulator valve can be adjusted to increase or decrease injection pressure
SVE Blower Temperature (°F)	4-20 mA Temperature Sensor	Blower Discharge Stack	SVE high temperature alarm can be reset
Air Compressor Discharge Temperature (°F)	4-20 mA Temperature Sensor	Compressor Discharge Line	Compressor high temperature alarm can be reset
SVE Blower Flow Rate (cfm)	4-20 mA Differential Pressure Sensor	Blower Influent Vacuum Line	Make up air valve can be adjusted to increase or decrease flow from wells. Zero flow rate alarm can be reset remotely.
AS Compressor Discharge Flow Rate (cfm)	4-20 mA Differential Pressure Sensor	Compressor Discharge Line	Discharge line regulator valve can be adjusted to increase or decrease flow rate to wells. Zero flow rate alarm can be reset remotely.
SVE Well Flow Rate (cfm)	4-20 mA Differential Pressure Sensors	SVE Manifold	Make up air valve can be adjusted to increase or decrease flow from wells
Air Sparge Well Flow Rate (cfm)	4-20 mA Differential Pressure Sensors	AS Manifold	Discharge line regulator valve can be adjusted to increase or decrease flow rate to wells
SVE Blower Motor Run Time (hrs)	Timer	Control Panel	Monitored remotely
Air Compressor Motor Run Time (hrs)	Timer	Control Panel	Monitored remotely
Alert/Alarm Conditions	NA	Control Panel	All alarm conditions can be reset remotely, if the alarm condition no longer exists

Table 2
Maintenance Schedule Summary
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

SECOR

Equipment	Description	Frequency
Air Sparge Wells	Inspect: - Surface seal integrity - Cover airtight seal integrity - Wellhead components integrity (valves, gauges, etc.) - Sediment accumulation within the wells (gauge wells - depth to bottom) - Wellbox integrity - Casing integrity	Monthly
Extraction Wells	Inspect: - Casing integrity - Surface seal integrity - Cover airtight seal integrity - Sediment accumulation within the wells - Wellbox integrity	Monthly
Air/Water Separator	Inspect: - Proper operation of flapper valve - Level probes for scaling - Separator for solids or sludge buildup	Monthly
Blower	Inspect: - Operating temperature - Amps under load	Monthly
Blower Filters	Inspect- change if dirty or when pressure increases by 20%	Monthly
Air Compressor	Inspect: - Operating temperature - Amps under load	Monthly
Air Compressor Filters	Inspect - change if dirty or when pressure increases by 20%	Monthly
Instrumentation	Inspect gauges and flow meters - clean or replace as necessary	Monthly
Piping, Fittings, and Valves	Inspect	Monthly
Vapor Phase GAC	Inspect and replace as necessary	Monthly

SECOR

Table 3
Vapor Monitoring for the AS and SVE Treatment System
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Sample Location	Initial Baseline Sample	Initial Startup Week 1	Initial Startup Weeks 2 - 6	Normal Operation **
SVE-1	Yes	Sample Once	Sample Weekly	Sample Quarterly
SVE-2	Yes	Sample Once	Sample Weekly	Sample Quarterly
SVE-3	Yes	Sample Once	Sample Weekly	Sample Quarterly
SVE-4	Yes	Sample Once	Sample Weekly	Sample Quarterly
SVE-5	Yes	Sample Once	Sample Weekly	Sample Quarterly
SVE-6	Yes	Sample Once	Sample Weekly	Sample Quarterly
Influent to GAC	No	Sample Daily	Sample Weekly*	Sample Monthly*
Intermediate GAC	No	Sample Daily	Sample Weekly*	Sample Monthly*
Effluent GAC	No	Sample Daily	Sample Weekly*	Sample Monthly*

Note: The initial SVE baseline samples and monthly air emission samples will be analyzed via USEPA method T0-14. Periodic SVE and GAC system monitoring will be performed with an 11.7eV (or equivalent) PID.

* Subject to change based on time period for first breakthrough of primary carbon and system performance monitoring data.

** Normal Operation may change from the initial 5 hour operation per treatment cell to another schedule and may evolve to be periodic operation (or only a portion of the treatment cells and wells) based on the system performance.

Table

Vacuum and Water Level Monitoring for AS and SVE Treatment System
Area 9/10 - Southeast Rockford Groundwater Contamination Site
Rockford, Illinois

SECOR

Well ID	Screen Interval (ft bgs)	Location Relative to Treatment Area	Week 1	Weeks 2 - 5	Normal Operation**
GMZ Monitoring Wells					
SMW-20	30-45	In central portion of treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	Monthly Vacuum and Water Levels
SMW-21	30-45	In central portion of treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	Monthly Vacuum and Water Levels
GMZ-2	30-45	Adjacent to treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	Monthly Vacuum and Water Levels
GMZ-3	30-45	Adjacent to treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	Monthly Vacuum and Water Levels
GMZ-4	30-45	Adjacent to treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	Monthly Vacuum and Water Levels
Additional Wells That May Be Monitored					
SMW-4	30-45	210' NW of treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
SMW-5	30-45	50' W of treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
SMW-6	30-45	30' S of treatment zone, in vacuum ROI of extraction wells	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
SMW-7	30-45	45' S of treatment zone, in vacuum ROI of extraction wells	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
SMW-8	30-45	250' NW of treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
SMW-15	30-45	250' N of treatment zone	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
SMW-22	30-45	30' E of treatment zone, in vacuum ROI of extraction wells	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis
MW201	30-45	20' S treatment zone, in vacuum ROI of extraction wells	Daily Vacuum and Water Levels	Weekly Vacuum and Water Levels	On An As Needed Basis

** Normal Operation may change from the initial 5 hour operation per treatment cell to another schedule and may evolve to be periodic operation (or only a portion of the treatment cells and wells) based on the system performance.

Baseline and Periodic Groundwater Monitoring for AS and SVE Treatment System
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Well ID	Screen Interval (ft bgs)	Location Relative to Treatment Area	Week 1	Weeks 2 - 5	Normal Operation**
GMZ Monitoring Wells					
SMW-20	30-45	In central portion of treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	Quarterly Sampling for Year 1
SMW-21	30-45	In central portion of treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	Quarterly Sampling for Year
GMZ-2	30-45	Adjacent to treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	Quarterly Sampling for Year 1
GMZ-3	30-45	Adjacent to treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	Quarterly Sampling for Year 1
GMZ-4	30-45	Adjacent to treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	Quarterly Sampling for Year 1
Additional Wells That May Be Monitored					
SMW-4	30-45	210' NW of treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
SMW-5	30-45	50' W of treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
SMW-6	30-45	30' S of treatment zone, in vacuum ROI of extraction wells	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
SMW-7	30-45	45' S of treatment zone, in vacuum ROI of extraction wells	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
SMW-8	30-45	250' NW of treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
SMW-15	30-45	250' N of treatment zone	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
SMW-22	30-45	30' E of treatment zone, in vacuum ROI of extraction wells	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis
MW 201	30-45	20' S treatment zone, in vacuum ROI of extraction wells	Baseline Sampling Prior to Start Up	Quarterly Sampling	On An As Needed Basis

** Normal Operation may change from the initial 5 hour operation per treatment cell to another schedule and may evolve to be periodic operation (or only a portion of the treatment cells and wells) based on the system performance.

Baseline and quarterly samples to be analyzed for VOCs by USEPA Method 8260B. GMZ wells will also be analyzed for Natural Attenuation Parameters.

SECOR

Table 6
Vapor Monitoring TO-14 VOC Parameters
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Parameters
1,1,2-Trichloroethane
1,2,4-Trichlorobenzene
1,3-Dichloropropene
1,4-Dichlorobenzene
Acrylonitrile (2-propenenitrile)
Allyl chloride (3-chloropropene)
Benzene
Benzyl chloride (a-chlorotoluene)
Carbon tetrachloride
Chlorobenzene; C6H5C1
Chloroform
Ethyl chloride (chloroethane)
Ethylbenzene
Ethylene dibromide (1,2-dibromoethane)
Hexachlorobutadiene
Hexane
1,1,2,2-Tetrachloroethane
Methy bromide (bromomethane)
Methylchloroform (1,1,1-trichloroethane)
m-Xylene
Styrene

Table 7
Groundwater Management Zone Groundwater Monitoring VOC Parameters
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

SECOR

Parameter
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,2-Dichloroethane
1,2-Dichloroethene (total)
1,2-Dichloropropane
2-Butanone (MEK)
2-Hexanone
4-Methyl-2-pentanone (MIBK)
Acetone
Benzene
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,3-Dichloropropene
Ethylbenzene
Methylene chloride
Styrene
Tetrachloroethene
Toluene
trans-1,3-Dichloropropene
Trichloroethene
Vinyl chloride
Xylenes (total)

USEPA Method 8260B

Table 8
Groundwater Management Zone Natural Attenuation Parameters and Analytical Methods
Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Parameter	Method of Evaluation (USEPA or Other)	Concentration in Source Zone or Change from Background	Explanation of Likely Reductive Dechlorination Activity
Arsenic (As")	6020	Increase over background	Mobilized under anaerobic conditions if As present.
Chloride	9056	> 2x background	From dechlorination. Environmental factors may interfere (e.g., road salt). Initial contaminant concentrations may be too low to detect a significant increase in cr.
Dissolved Oxygen (D.O.)	Field Measurement	< 0.5 mg/l	Oxygen suppresses reductive dechlorination. CisDCE, 1,1-DCE, 1,1-DCA, VC, methylene chloride, and chloromethane may degrade aerobically.
Ethane	AM20GAX	Present	Daughter product of reductive dechlorination of 1,1,1-TCA. Also produced from ethene.
Ethene	AM20GAX	Present	Daughter product of reductive dechlorination of VC.
Ferrous Iron (Fe^{+})	3500	Increase over background	Reductive dechlorination may take place under iron reducing conditions. VC may be oxidized under these conditions.
Hydrogen (H_2)	AM20GAX	> 1 nM	Reductive dechlorination possible. VC may accumulate.
Hydrogen (H_2)	AM20GAX	< 1 nM	VC oxidized. Reductive dechlorination may not occur.
Manganese (Mn^{+2})	7199(M)	Increase over background	If present on soil surfaces, Mn serves as an electron donor. Reductive dechlorination may not take place under Mn reducing conditions.
Methane	AM20GAX	Increase over background	Indicates the most reduced groundwater conditions. VC accumulates at methane >0.5 mg/l.
Nickel	6020	Increase over background	Mobilized under anaerobic conditions if Ni present.
Nitrate (NO3)	9056	< 1 mg/l	Presence of NO-' suppresses reductive dechlorination. Methylene chloride, VC, other low chlorinated compounds may degrade in the presence of NO^{-3}.
Oxidation Reduction Potential (ORP) with Ag/AgCl electrode	Field Measurement	<-100 mV <50 mV	Reductive dechlorination likely. Reductive dechlorination possible.
pH	Field Measurement	5 < pH > 9	Optimal range for microbial activity.
Specific Conductance	Field Measurement	Increase over background	General water quality parameter; helps determine that sample is collected from the same groundwater system.
Sulfate ($SO4^{2}$)	9056	Decrease compared to background	Reductive dechlorination may occur under SO_4^{-2} reducing conditions. However, high levels of $SO4^{2}$ can inhibit reductive dechlorination.
Sulfide (S)	9034	Increase over background	Reductive dechlorination may occur. V may not be detected because of precipitation with Fe^{+2}.
Temperature	Field Measurement		Affects microbial energetics. At cooler temps, dechlorination can proceed at lower H2 levels.
Total Inorganic Carbon (TIC)	5310(M)	Increase over background	Measures CO_2 species produced by microbial metabolism.
Total Organic Carbon (TOC)	5310	> 20 mg/l	Source of organic carbon necessary as driver for reductive dechlorination to proceed. Anthropogenic sources of carbon include BETX

Note: Comprehensive analysis of all parameters will be completed quarterly in year 1. Thereafter selective analysis will be identified based on the year 1 dataset.
Based on the Wisconsin DNR Publication RR-699, "Understanding Chlorinated Hydrocarbon Behavior in Groundwater: Investigation, Assessment and Limitations of Monitored Natural Attenuation". Adapted from Wiedemeir, 1998.

FIGURES

AREA 9/10 REMEDIAL DESIGN
PRE-FINAL DESIGN
95% DESIGN

SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

CERCLIS ID NO. ILD981000417

JANUARY 2007

PREPARED BY

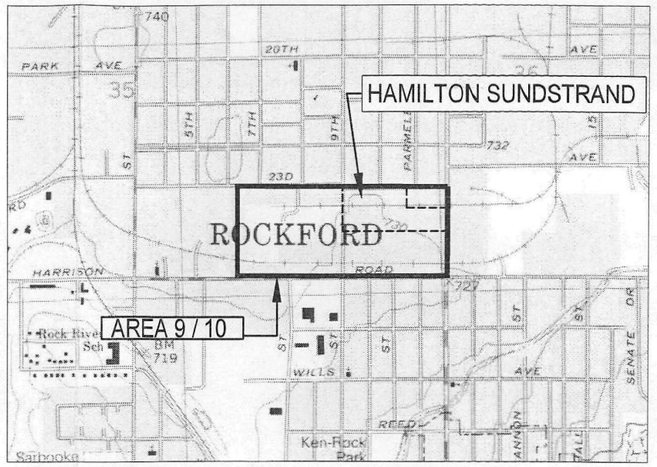
SECOR

446 EISENHOWER LANE NORTH
LOMBARD, ILLINOIS
PHONE: (630) 792-1680/792-1691 (FAX)

SECOR PN: 13UN.02072.04.0001

PRE-FINAL DESIGN 95% DESIGN

LOCATION MAP



REFERENCE: USGS 7.5 MINUTE QUADRANGLE; ROCKFORD SOUTH, ILLINOIS; 1993

0 1/2 1

APPROXIMATE SCALE (MILES)

QUADRANGLE LOCATION

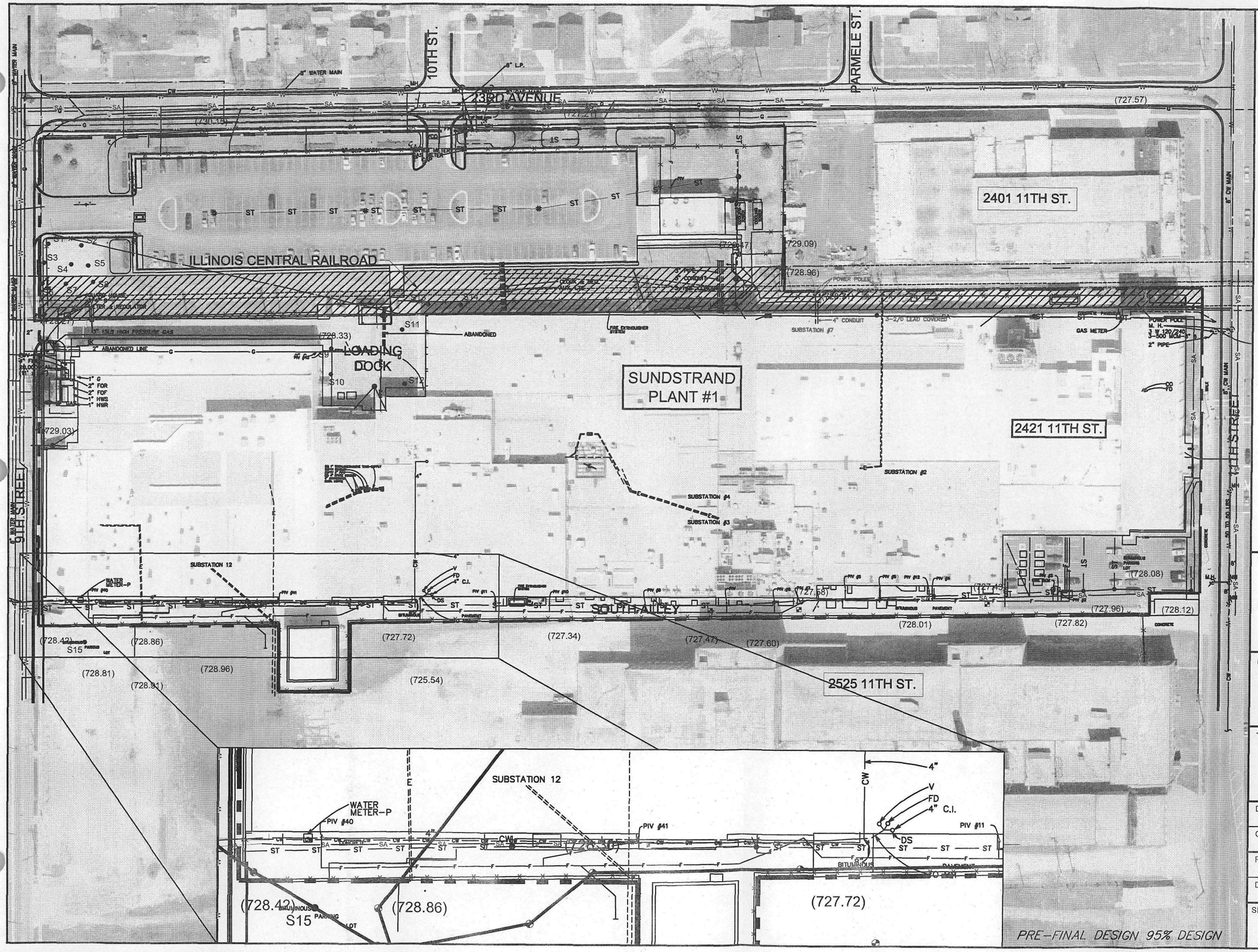
DRAWING INDEX

REV	DATE	DESCRIPTION	DSGN	CHCK	APPRV
A		ISSUED FOR REVIEW			
B		ISSUED FOR REVIEW			
0					
1					

DESIGNED BY: KTW
CHECKED BY: JGP
APPROVED BY: DMC
DRAWN BY: JC
DATE: 1/22/07

FILEPATH: F:\WORK\AUTOCAD\FIGURES\UTC

02072F17.DWG



N

LEGEND:

	PROPERTY BOUNDARY
	RAILROAD PROPERTY
F	FIRE PROTECTION WET
CW	COLD WATER
JS	JACKET SUPPLY
JS	JACKET RETURN
AS	AUXILIARY SUPPLY
AR	AUXILIARY RETURN
ST	STORM SEWER
SA	SANITARY SEWER
W	WATER MAIN
E	ELECTRICAL

NOTE:

HS LEASES LAND IDENTIFIED WITHIN THE PROPERTY BOUNDARY FROM ILLINOIS CENTRAL RAILROAD (OWNED BY CANADIAN NATIONAL RAILROAD) LEASE NO. 8565.

UTILITIES IN WORK AREAS TO BE FIELD VERIFIED BY CONTRACTORS

GAS, ELECTRIC, AND COMMUNICATION LINES NOT AVAILABLE ON PLANT DRAWINGS NO. 5077PF01 AND 6164P1

0 100 200

APPROXIMATE SCALE (FEET)

PREPARED BY:

SECOR

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

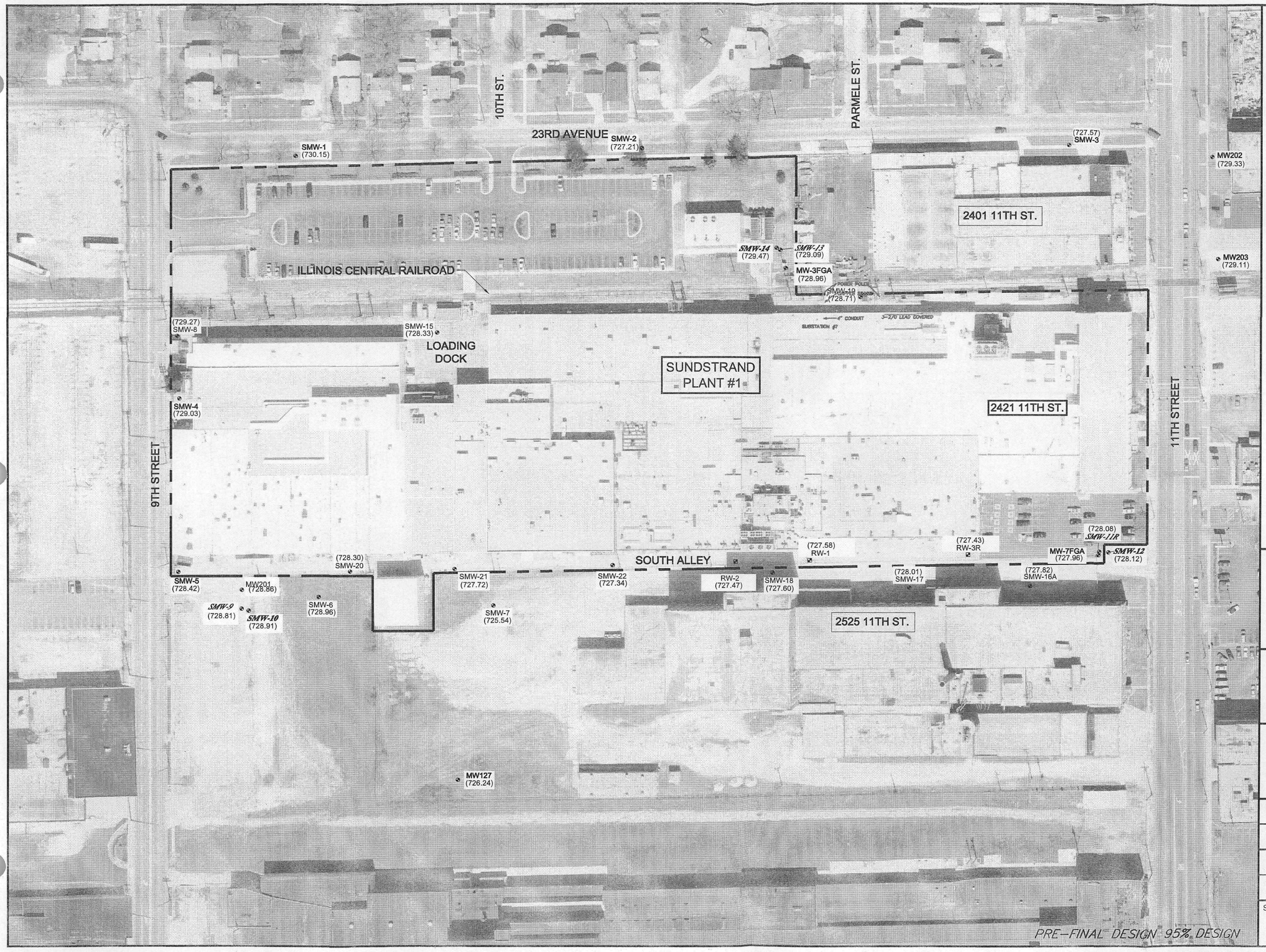
TITLE:

UTILITY AND PROPERTY OWNERSHIP MAP

DRAWN BY: JC	DESIGNED BY: KTW
CHECKED BY: JGP	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: AS SHOWN
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

SHEET: Y2

02072F16.dwg



N

LEGEND:

- PROPERTY BOUNDARY
- MONITORING WELL
- RECOVERY WELL
- (327.72) ELEVATION AT WELL LOCATION

NOTE:

GROUND SURFACE ELEVATION RELATIVE TO MEAN SEA LEVEL. FROM APRIL 2004 SURVEY COMPLETED BY MISSMAN STANLEY AND ASSOCIATES, P.C. OF ROCKFORD, ILLINOIS.

0 120 240

APPROXIMATE SCALE (FEET)

PREPARED BY:

SECOR

446 EISENHOWER LANE NORTH
LOMBARD, ILLINOIS 60148
PHONE: (630) 792-1680/792-1691 (FAX)

FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:

WELL LOCATIONS AND GROUND SURFACE ELEVATIONS

DRAWN BY: JC	DESIGNED BY: KTW
CHECKED BY: JGP	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: AS SHOWN
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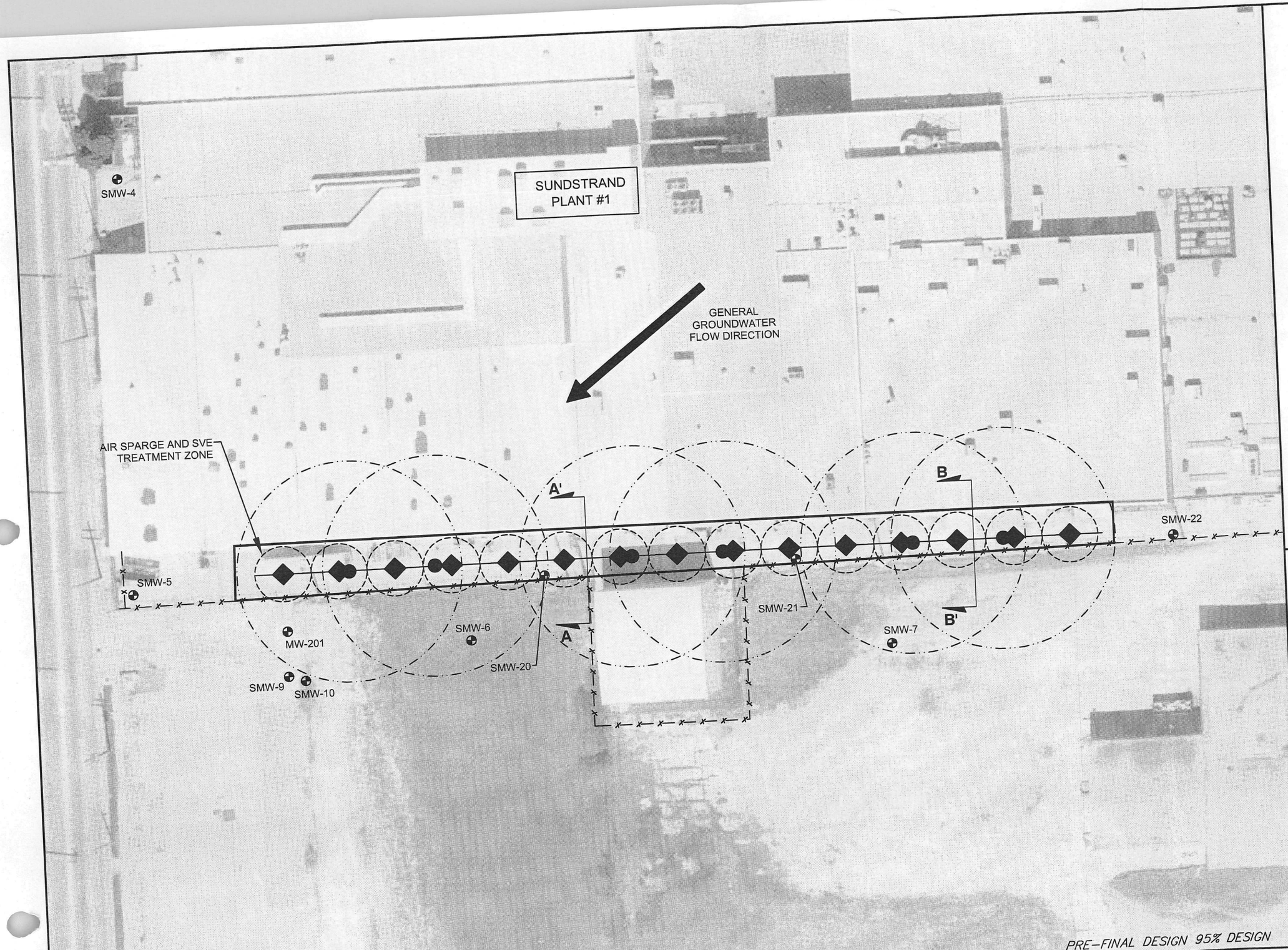
SHEET: Y3

02072F16.dwg



PRE-FINAL DESIGN 95% DESIGN

N

LEGEND

- MONITORING WELL
- FENCE LINE
- SVE WELL
- AIR SPARGE WELL
- SVE RADIUS OF INFLUENCE
- AIR SPARGE RADIUS OF INFLUENCE
- AIR SPARGE AND SVE GROUNDWATER REMEDIATION TREATMENT ZONE

0 50 100

APPROXIMATE SCALE (FEET)

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER
CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

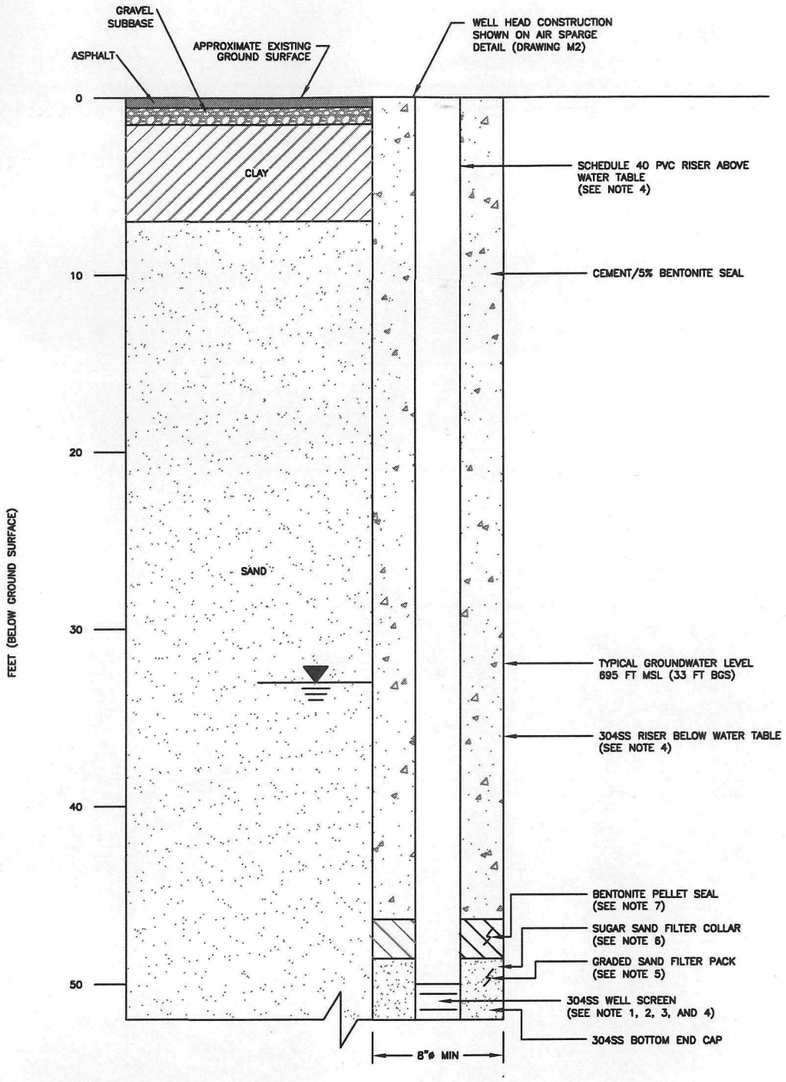
TITLE:

AIR SPARGE AND SOIL VAPOR EXTRACTION TREATMENT ZONE DETAILS

DRAWN BY: JC	DESIGNED BY: JGP
CHECKED BY: KTW	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: AS SHOWN
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

SHEET: Y5

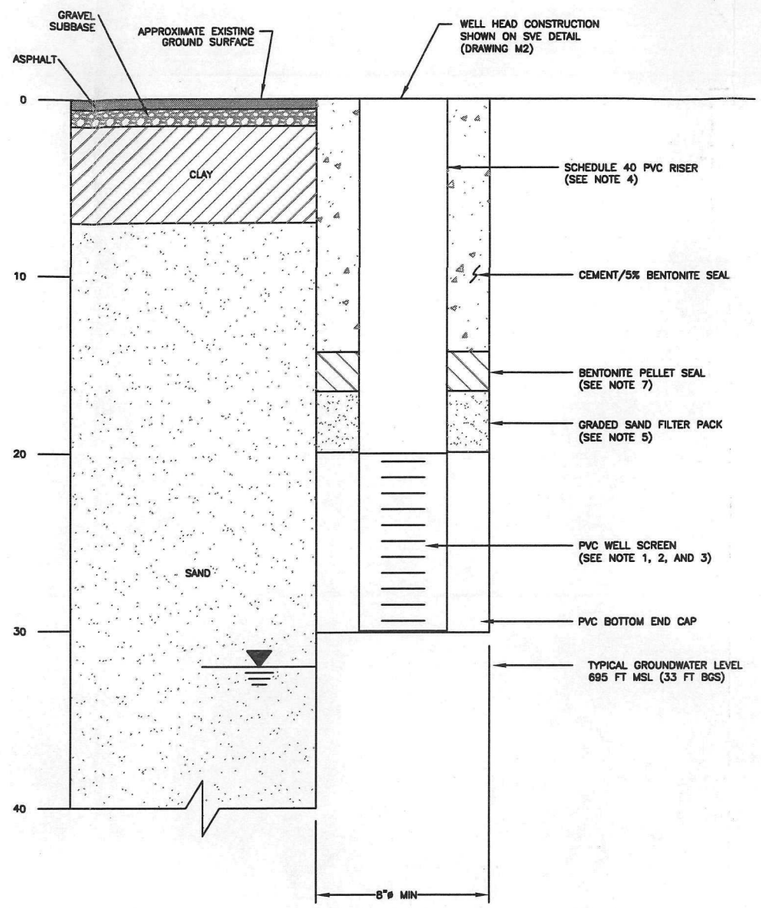
02072F18.dwg



AIR SPARGE WELL CONSTRUCTION
NOT TO SCALE

NOTES:

1. WELL SCREEN APPROXIMATELY 50–52 FEET (ELEVATION 676–678 FT ABOVE MSL) APPROXIMATELY 17–19 FT BELOW THE TYPICAL WATER TABLE ELEVATION.
2. WELL SCREEN (2 FEET LENGTH) WILL BE INSTALLED
3. SCREEN SLOT SIZE WILL BE 0.010
4. WELL SCREEN AND RISER TO BE 1.5 INCH DIAMETER
5. FILTER PACK SAND WILL BE RED FLINT #3545 (OR EQUIVALENT)
6. A 1 FOOT SUGAR SAND FILTER COLLAR SAND WILL BE PLACED ABOVE THE FILTER PACK.
7. BENTONITE PELLET SEAL EXTENDS APPROXIMATELY 3 FEET ABOVE TOP OF FILTER COLLAR.
8. ACTUAL DEPTH TO BOTTOM OF BOREHOLE WILL BE DETERMINED BY GEOLOGIST/ENGINEER IN THE FIELD.



SOIL VAPOR EXTRACTION WELL CONSTRUCTION
NOT TO SCALE

NOTES:

1. WELL SCREEN APPROXIMATELY 20–30 FEET (ELEVATION 698–708 FT ABOVE MSL) APPROXIMATELY 3 FT ABOVE THE TYPICAL WATER TABLE ELEVATION.
2. WELL SCREEN (10 FEET LENGTH) WILL BE INSTALLED
3. SCREEN SLOT SIZE WILL BE 0.010
4. WELL SCREEN AND RISER TO BE 4 INCH DIAMETER
5. FILTER PACK SAND WILL BE RED FLINT #3545 (OR EQUIVALENT)
6. A 1 FOOT SUGAR SAND FILTER COLLAR SAND WILL BE PLACED ABOVE THE FILTER PACK.
7. BENTONITE PELLET SEAL EXTENDS APPROXIMATELY 3 FEET ABOVE TOP OF FILTER COLLAR.
8. ACTUAL DEPTH TO BOTTOM OF BOREHOLE WILL BE DETERMINED BY GEOLOGIST/ENGINEER IN THE FIELD.

PRE-FINAL DESIGN 95% DESIGN

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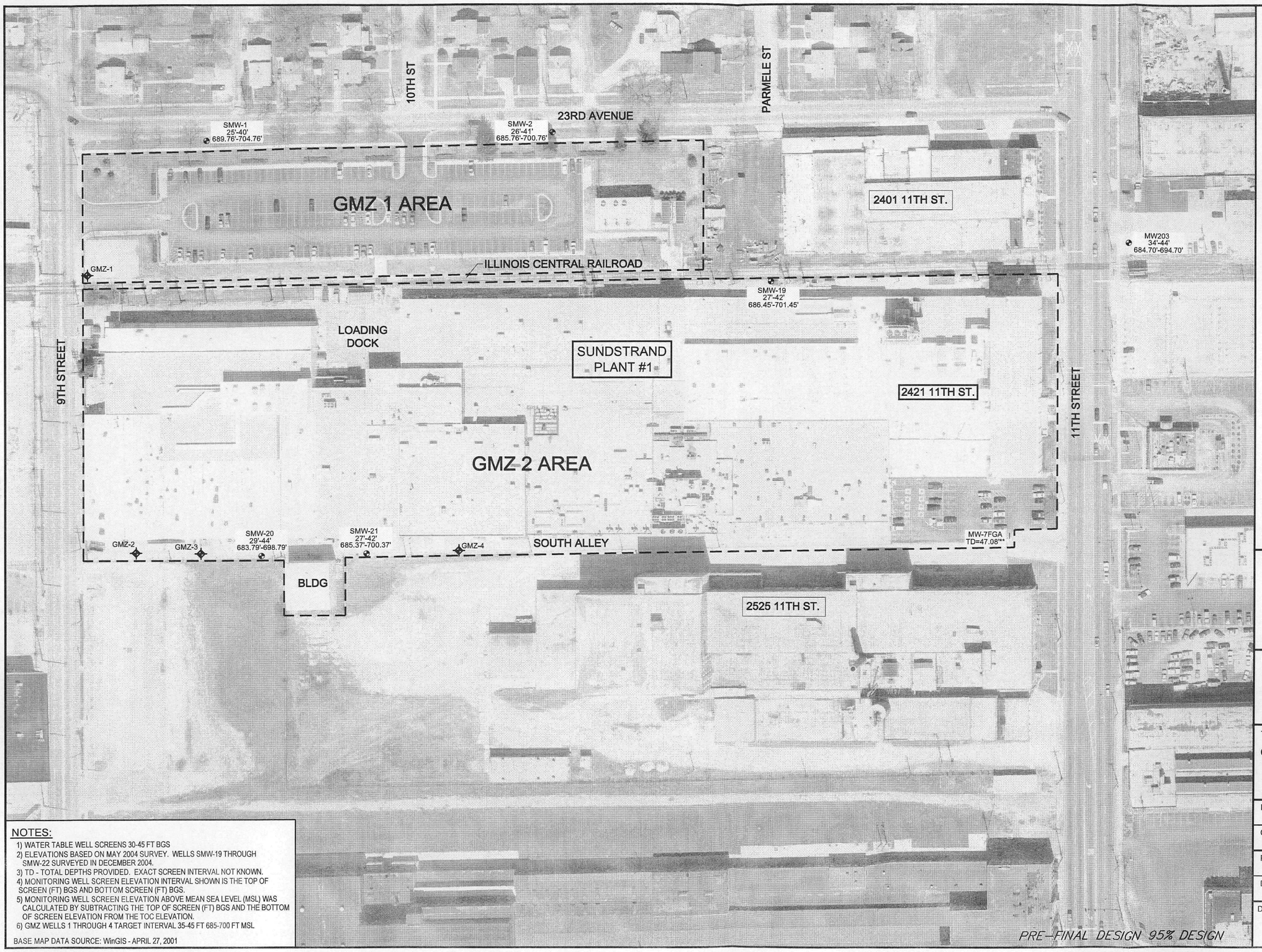
FOR:
AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:
WELL CONSTRUCTION DETAILS

DRAWN BY: JC	DESIGNED BY: KTW
CHECKED BY: JGP	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: NTS
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

SHEET: Y6

02072F17.dwg



NOTES:

1) WATER TABLE WELL SCREENS 30-45 FT BGS
2) ELEVATIONS BASED ON MAY 2004 SURVEY. WELLS SMW-19 THROUGH SMW-22 SURVEYED IN DECEMBER 2004.
3) TD - TOTAL DEPTHS PROVIDED. EXACT SCREEN INTERVAL NOT KNOWN.
4) MONITORING WELL SCREEN ELEVATION INTERVAL SHOWN IS THE TOP OF SCREEN (FT) BGS AND BOTTOM SCREEN (FT) BGS.
5) MONITORING WELL SCREEN ELEVATION ABOVE MEAN SEA LEVEL (MSL) WAS CALCULATED BY SUBTRACTING THE TOP OF SCREEN (FT) BGS AND THE BOTTOM OF SCREEN ELEVATION FROM THE TOC ELEVATION.
6) GMZ WELLS 1 THROUGH 4 TARGET INTERVAL 35-45 FT 685-700 FT MSL

BASE MAP DATA SOURCE: WinGIS - APRIL 27, 2001

LEGEND:

	MONITORING WELL
	RECOVERY WELL
	PROPOSED WELL
	GMZ BOUNDARY
31.16'-46.16'	MONITORING WELL SCREEN ELEVATION INTERVAL BELOW TOP OF CASING (feet)
681.88'-696.88'	MONITORING WELL SCREEN ELEVATION (feet) MEAN SEA LEVEL
*	BASED ON RW-3 SURVEY DATA
**	TOTAL DEPTH WAS MEASURED ON JANUARY 14-15, 2004

0 120 240

APPROXIMATE SCALE (FEET)

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:

GMZ MONITORING WELL NETWORK AND SCREEN DEPTHS

DRAWN BY: JC	DESIGNED BY: KTW
CHECKED BY: KTW	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: AS SHOWN
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

DRAWING: D8

PRE-FINAL DESIGN 95% DESIGN

02072F19

VALVE AND PIPING SYMBOLS

- GATE VALVE
- RELIEF OR SAFETY VALVE
- BALL VALVE
- NO NORMALLY OPEN
- NC NORMALLY CLOSED
- FLEXIBLE HOSE
- AIR RELEASE VALVE
- REDUCER
- UNION
- CLEANOUT (CO)
- REMOVABLE CAP
- EXHAUST TO ATMOSPHERE (INSIDE)
- EXHAUST TO ATMOSPHERE (OUTSIDE)
- QUICK DISCONNECT COUPLING
- GAUGE SEAL
- AIR INLET
- AIR EXHAUST

VALVE OPERATOR SYMBOLS

- S SOLENOID
- T HANDWHEEL OR LEVER
- A ACTUATOR

PRIMARY ELEMENT SYMBOLS – FLOW

- PITOT TUBE
- VENTURI OR FLOW TUBE
- M ROTAMETER
- FLOW METER

EQUIPMENT SYMBOLS

- BLOWER/COMPRESSOR
- AIR/WATER SEPERATOR TANK
- PSI PRESSURE MEASUREMENT
- TI TEMPERATURE INDICATOR
- VI VACUUM INDICATOR
- AIR FILTER
- WELL (AIR SPARGE OR SVE)
- HPS PRESSURE SWITCH

GENERAL INSTRUMENT SYMBOLS

ONE VARIABLE	TWO VARIABLES	
○	○○	LOCALLY MOUNTED
⊖	⊖⊖	PANEL MOUNTED
⊖	⊖⊖	REAR-OF-PANEL MOUNTED
I		INTERLOCK
P		PURGE

LINE SYMBOLS

- PROCESS PIPES OR CHANNELS
- CONNECTION TO PROCESS, MECHANICAL LINK OR INSTRUMENT SUPPLY
- PNEUMATIC SIGNAL
- ELECTRIC SIGNAL
- CAPILLARY TUBING (FILLED SYSTEM)
- HYDRAULIC SIGNAL
- ELECTROMAGNETIC OR SONIC SIGNAL NO WIRING OR TUBING

INSTRUMENT IDENTIFICATION TABLE

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	BURNER FLAME				
C	CONDUCTIVITY			CONTROL	CLOSED
D	DENSITY (SP. GR.)	DIFFERENTIAL			
E	VOLTAGE		PRIMARY ELEMENT		
F	FLOW RATE	RATIO			
G	GAUGING (DIMENSIONAL)		GLASS		
H	HAND (MANUAL)				HIGH
I	CURRENT		INDICATE		
J	POWER	SCAN			
K	TIME OR SCHEDULE			CONTROL STATION	
L	LEVEL		LIGHT (PILOT)		LOW
M	MOISTURE OR HUMIDITY		MEASUREMENT		MIDDLE
N	NORMALLY				
O			ORIFICE		
P	PRESSURE OR VACUUM		POINT (TEST)		
Q	QUANT. OR EVENT	INTEGRATE			
R	RADIOACTIVITY		RELIEF		
S	SAMPLE	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION		
V	VACUUM			VALVE OR DAMPER	
W	WEIGHT OR FORCE		WELL		
X	UNCLASSIFIED		UNCLASSIFIED		
Y				RELAY OR COMPUTE	
Z	POSITION			DRIVE, ACTUATE	

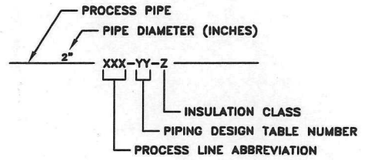
PROCESS LINE ABBREVIATIONS

AIR	AIR, ATMOSPHERIC PRESSURE
BW	BACKWASH
CA	COMPRESSED AIR
D	DRAIN
EFF	EFFLUENT
EXH	EXHAUST
NPW	NON-POTABLE WATER
PW	POTABLE WATER
S	SANITARY
SL	SLUDGE
SP	SAMPLE PORT
SS	STORM SEWER
V	VENT
VAP	VAPOR

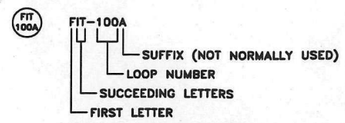
PIPING MATERIAL IDENTIFICATION

CPVC	CHLORINATED POLYVINYL CHLORIDE
CSP	CARBON STEEL PIPE
COP	COPPER
CMP	CORRUGATED METAL PIPE
CIP	CAST IRON PIPE
DIP	DUCTILE IRON PIPE
GAL	GALVANIZED STEEL PIPE
GSD	GALVANIZED STEEL DUCTING
HDPE	HIGH DENSITY POLYETHYLENE
PE	POLYETHYLENE PIPE
PP	POLYPROPYLENE PIPE
PVC	POLYVINYL CHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
RUB	RUBBER HOSE
SS	STAINLESS STEEL PIPE
VCP	VITRIFIED CLAY PIPE

PROCESS PIPING IDENTIFICATION



INSTRUMENT IDENTIFICATION



FUNCTION ABBREVIATIONS

DO	DISSOLVED OXYGEN	OC	OPEN-CLOSE
FC	FAIL CLOSED	OO	ON-OFF (MAINTAINED)
FI	FAIL INDETERMINATE	ORP	OXIDATION REDUCTION POTENTIAL
FL	FAIL LOCKED	OSC	OPEN-STOP-CLOSE (MOMENTARY)
FO	FAIL OPEN	SS	START-STOP (MOMENTARY)
FQI	FLOW QUALITY INDICATOR	>	HIGH SELECT
HOA	HAND-OFF-AUTOMATIC	<	LOW SELECT
I/I	CURRENT-TO-CURRENT	√	SQUARE ROOT
I/P	CURRENT-TO-PNEUMATIC	Σ	ADD OR TOTALIZE
LEL	LOWER EXPLOSIVE LIMIT		
LR	LOCAL-REMOTE		

PRE-FINAL DESIGN 95% DESIGN

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:

PIPING AND INSTRUMENTATION DIAGRAM LEGEND

DRAWN BY: JC	DESIGNED BY: JGP
CHECKED BY: KTW	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: NOT APPLICABLE
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

SHEET: P1

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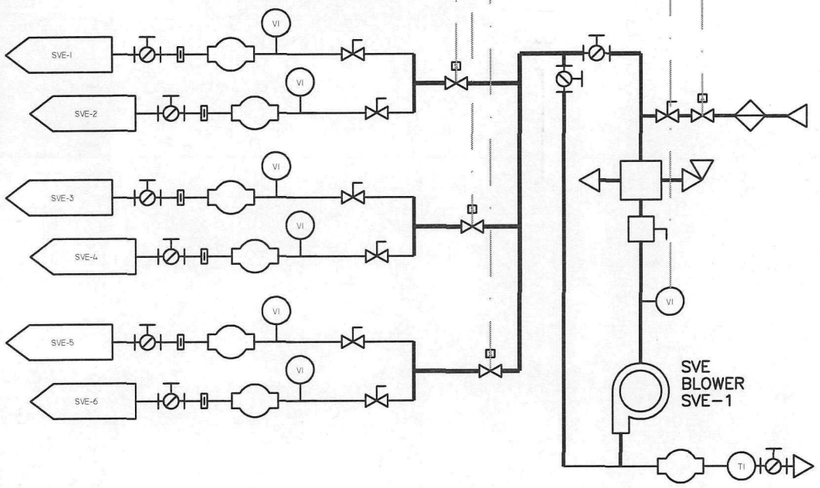
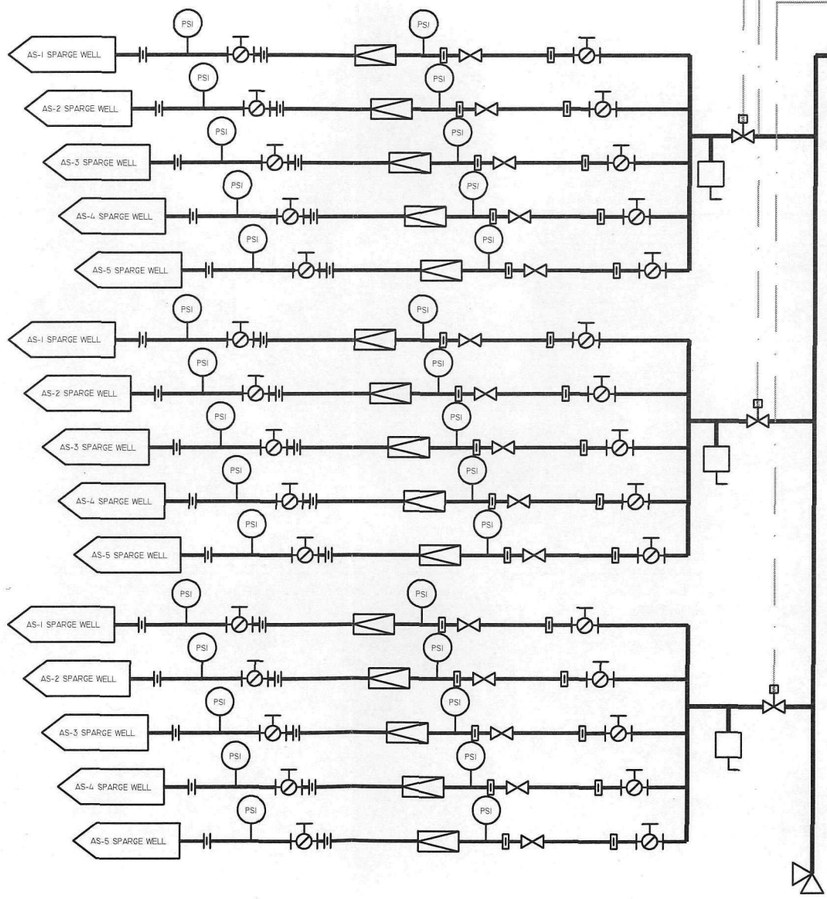


SOIL VAPOR EXTRACTION



AIR SPARGE SYSTEM

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER
CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:

AIR SPARGE, SOIL VAPOR EXTRACTION, TREATMENT PIPING AND INSTRUMENTATION DIAGRAM

DRAWN BY: JC	DESIGNED BY: JGP
CHECKED BY: KTW	APPROVED BY: DMC
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SHEET: P2

PRE-FINAL DESIGN 95% DESIGN

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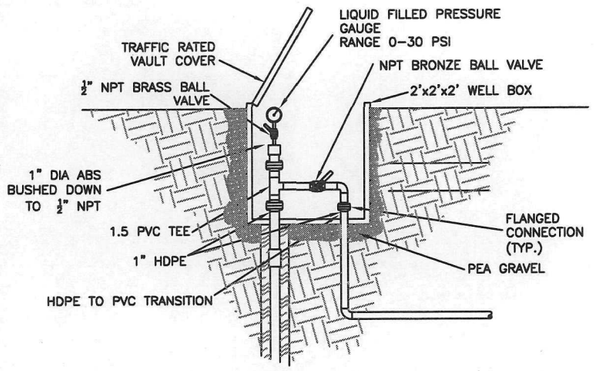
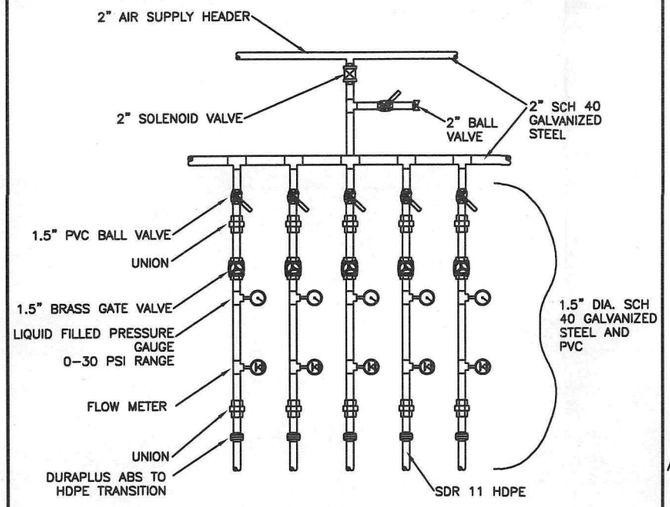
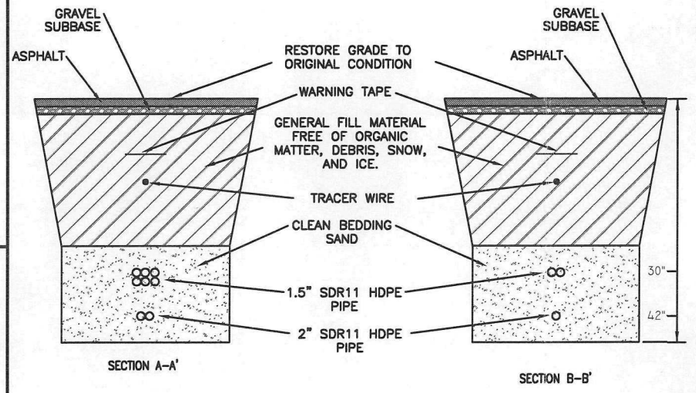


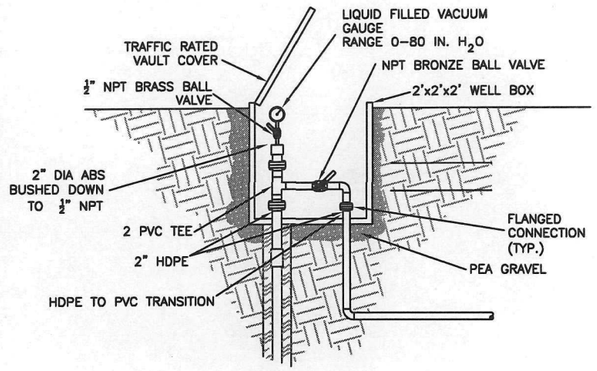
AIR SPARGE WELL HEAD
NOT TO SCALE



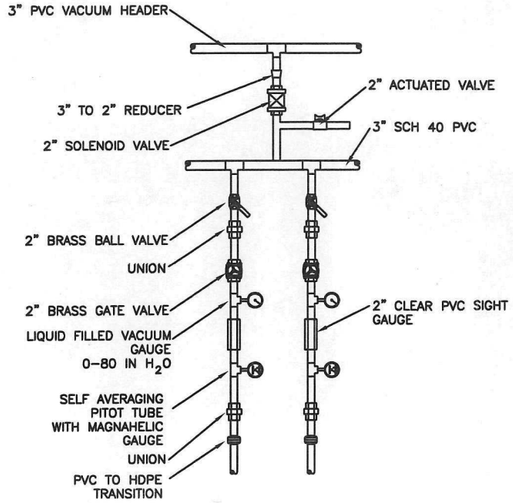
AIR SPARGE MANIFOLD DETAIL
NOT TO SCALE



TRENCH DETAIL
NOT TO SCALE



SVE WELL HEAD
NOT TO SCALE



SVE MANIFOLD DETAIL
NOT TO SCALE

PRE-FINAL DESIGN 95% DESIGN

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FOR:
AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:
AIR SPARGE AND SOIL VAPOR EXTRACTION PIPING DETAILS

DRAWN BY: JC	DESIGNED BY: JGP
CHECKED BY: KTW	APPROVED BY: DMC
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SHEET: M2

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ONE-LINE DIAGRAM SYMBOLS

- CIRCUIT AND EQUIPMENT INSTALLED BY THIS CONTRACT
- EQUIPMENT ENCLOSURE
- CONTROL OR INTERLOCK CIRCUIT
- CONNECTION
- MOLDED CASE CIRCUIT BREAKER
- FUSE
- FUSED DISCONNECT SWITCH
- CIRCUIT BREAKER
  - ♣ CB MAXIMUM RATING
  - ♠ CONT AMP RATING
  - ♥ T= THERMAL/MAGNETIC F=FUSED
  - ♦ NUMBER OF POLES
- FULL VOLTAGE, NON-REVERSING (FVNR) MAGNETIC MOTOR STARTER
- MANUAL MOTOR STARTER
- AS — AMMETER SWITCH
- VS — VOLTMETER SWITCH
- A — AMMETER
- V — VOLTMETER
- RECEPTACLE–CLASS I, DIVISION 1, GROUPS C, D
- STARTER CONTACTOR
  - ♣ NEMA SIZE /IEC
  - ♦ SCHEMATIC DIAGRAM
  - ♥ M=MAGNETIC / N=MANUAL
  - ♠ FVNR=FULL VOLTAGE NON-REVERSING
  - FVR =FULL VOLTAGE REVERSING
  - RVNR=REDUCED VOLTAGE
  - 2S2W=2 SPEED, 2 WINDING
  - 2S1W=2 SPEED, 1 WINDING
  - VFD= VARIABLE FREQUENCY DRIVE
  - C= CONTACTOR
- FUSED POTENTIAL TRANSFORMERS
- CURRENT TRANSFORMER
- POWER TRANSFORMER
- LIGHTNING OR SURGE ARRESTER
- GROUND CONNECTION
- WHM — WATT-HOUR METER SOCKET. METER FURNISHED BY UTILITY.
- 5 — MOTOR – NUMBER INDICATES HP

PLAN SYMBOLS

- NEW CONSTRUCTION
- EXISTING CONSTRUCTION
- EXISTING CONSTRUCTION TO BE REMOVED
- CONDUIT EXPOSED
- CONDUIT CONCEALED IN WALL CEILING OR HIDDEN FROM VIEW
- CONDUIT CONCEALED IN FLOOR OR UNDERGROUND
- FLEXIBLE CONDUIT (LIQUIDTIGHT)
- GROUND CABLE
- BOLTED GROUND CONNECTION
- WELDED GROUND CONNECTION
- GROUND ROD
- HOMERUN. ARROWHEADS INDICATE NUMBER OF CIRCUITS
- CONDUIT TURNING UP
- CONDUIT TURNING DOWN
- CONDUIT WITH BUSHING
- CONDUIT TERMINATED OR CAPPED
- POWER PANEL–480V, 3ø
- LIGHTING PANEL–120/240V, 1ø OR 208/120V, 3ø
- DISCONNECT (SAFETY) SWITCH
- MS — MANUAL MOTOR STARTER
- MAGNETIC MOTOR STARTER
- COMBINATION MAGNETIC MOTOR STARTER
- 5 — MOTOR–NUMBER INDICATES HP
- P — PULLBOX
- J — JUNCTION BOX
- EXIT LIGHT
- L-1 — FLUORESCENT LUMINAIRE TYPE L-1
- L-1 — INCANDESCENT OR H.I.D. LUMINAIRE TYPE L-1
- EMERGENCY LIGHTING UNIT
- EMERGENCY FLUORESCENT LIGHTING FIXTURE
- DUPLEX RECEPTACLE WP–WEATHERPROOF GFCI–GROUND FAULT CIRCUIT INTERRUPTER
- RECEPTACLE–CLASS I, DIVISION 1, GROUPS C, D
- T — THERMOSTAT
- S — SINGLE POLE SWITCH
- S3 — THREE-WAY SWITCH
- S4 — FOUR-WAY SWITCH

SCHEMATIC DIAGRAM SYMBOLS

- TERMINAL
- CONDUCTOR CONNECTION
- NO CONNECTION
- GROUND
- CONTACT NORMALLY OPEN (NO)
- CONTACT NORMALLY CLOSED (NC)
- SWITCH
- SELECTOR SWITCH
- PUSHBUTTON–NORMALLY OPEN MOMENTARY
- PUSHBUTTON–NORMALLY CLOSED MOMENTARY
- PRESSURE OR VACUUM SWITCH–CLOSES WITH INCREASING PRESSURE OR DECREASING VACUUM
- PRESSURE OR VACUUM SWITCH–OPENS WITH INCREASING PRESSURE OR DECREASING VACUUM
- LIMIT SWITCH NO
- LIMIT SWITCH NO–HELD CLOSED
- LIMIT SWITCH NC
- LIMIT SWITCH NC–HELD OPEN
- NO TIME DELAY CONTACT. TIME DELAY CLOSING AFTER ENERGIZATION
- NC TIME DELAY CONTACT. TIME DELAY OPENING AFTER ENERGIZATION
- NO TIME DELAY CONTACT. TIME DELAY OPENING AFTER DE–ENERGIZATION
- NC TIME DELAY CONTACT. TIME DELAY CLOSING AFTER DE–ENERGIZATION
- M — MOTOR STARTER COIL
- RELAY COIL
- G — INDICATING LIGHT–COLOR INDICATED
  - A–AMBER R–RED
  - BL–BLUE Y–YELLOW
  - G–GREEN W–WHITE
- FLOW SWITCH–OPENS WITH INCREASING FLOW
- FLOW SWITCH–CLOSES WITH INCREASING FLOW
- LIQUID LEVEL SWITCH–CLOSES ON RISING LEVEL
- LIQUID LEVEL SWITCH–OPENS ON RISING LEVEL
- TEMPERATURE SWITCH–CLOSES ON RISING TEMPERATURES
- TEMPERATURE SWITCH–OPENS ON RISING TEMPERATURES
- SOLENOID VALVE COIL
- 3 OL — THERMAL OVERLOAD RELAY CONTACT NUMBER INDICATES NUMBER OF CONTACTS
- FUSE
- CONTROL POWER TRANSFORMER (CPT)
- H — HORN
- B — BELL

GENERAL ABBREVIATIONS

A, AUTO	AUTOMATIC	H	HAND	PLC	PROGRAMMABLE LOGIC CONTROLLER
ACK	ACKNOWLEDGE	HI	HIGH	REM	REMOTE
AFF	ABOVE FINISH FLOOR	HS	HIGH SPEED	REV	REVERSE
AFG	ABOVE FINISH GRADE	IL	INDICATING LIGHT	SOL	SOLENOID (OTHER THAN VALVE)
BC	BARE COPPER	INST	INSTANTANEOUS	SP	SPARE
C	CONDUIT	L	LOW	SS	SELECTOR SWITCH
CB	CIRCUIT BREAKER	LOC	LOCAL	SV	SOLENOID VALVE
CL	CLOSE	LS	LOW SPEED	T, T–STAT	THERMOSTAT
CPT	CONTROL POWER TRANSFORMER	MAN	MANUAL	TDAE	TIME DELAY AFTER ENERGIZATION
CR	CONTROL RELAY	MCC	MOTOR CONTROL CENTER	TDAD	TIME DELAY AFTER DE–ENERGIZATION
CS	CONTROL SWITCH	NC	NORMALLY CLOSED	TDR	TIME DELAY RELAY
CT	CURRENT TRANSFORMER	NL	NIGHT LIGHT (UNSWITCHED FIXTURE)	TEMP	TEMPERATURE
DWG	DRAWING	NO	NORMALLY OPEN	TMR	TIMER
ETM	ELAPSED TIME METER	O	OFF	WP	WEATHERPROOF
FU	FUSE	OL	THERMAL OVERLOAD RELAY	XFMR	TRANSFORMER
FWD	FORWARD	OP	OPEN	XP	EXPLOSIONPROOF–CLASS I, DIVISION I, GROUPS C, D
GND	GROUND	PB	PUSHBUTTON		

PRE-FINAL DESIGN 95% DESIGN

PREPARED BY:

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:

ELECTRICAL SYMBOLS LEGEND

DRAWN BY: JC	DESIGNED BY: JGP
CHECKED BY: KTW	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: NTS
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

SHEET: E1

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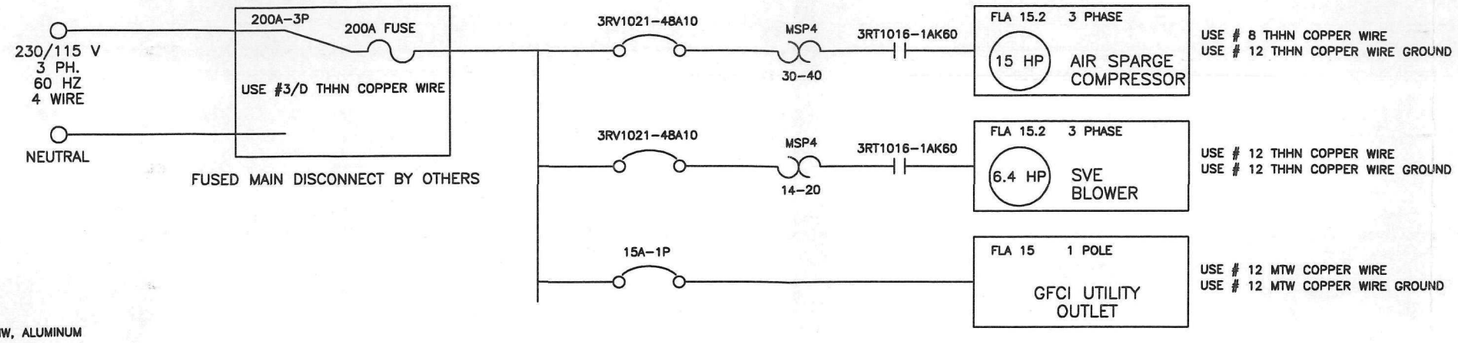

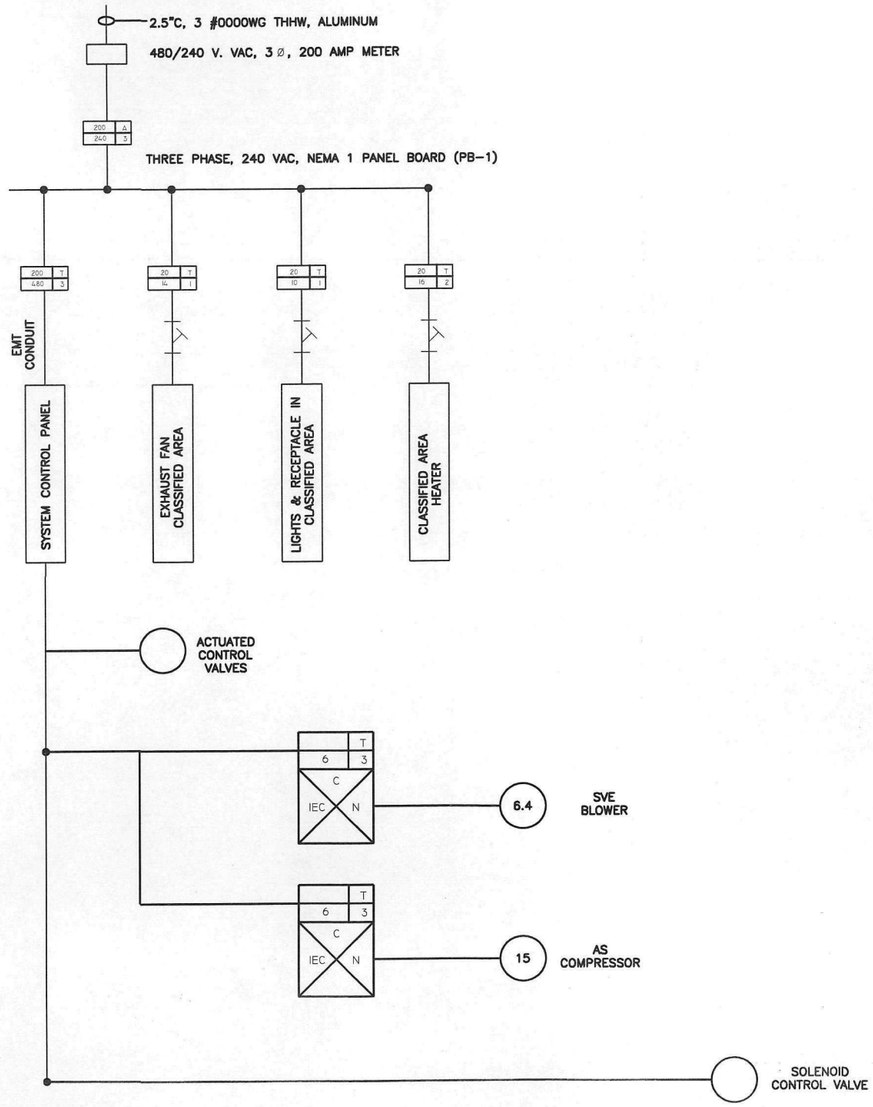

NOTES:

1.) ALL INSTRUMENTATION TO BE CONNECTED TO CONTROL PANEL USING 1/2" EMT CONDUITS WITH SEAL-OFFS

2.) SEAL-OFFS TO BE POURED AFTER FINAL INSPECTION

PREPARED BY:

SECOR

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FOR:

AREA 9/10 REMEDIAL DESIGN
SOUTHEAST ROCKFORD GROUNDWATER CONTAMINATION SUPERFUND SITE
ROCKFORD, ILLINOIS

TITLE:

ELECTRICAL ONE-LINE DIAGRAM

DRAWN BY: JC	DESIGNED BY: JGP
CHECKED BY: KTW	APPROVED BY: DMC
PROJECT NUMBER: 13UN.02072.04	SCALE: NTS
DATE: 1/22/07	FILE PATH: F:\WORK\AUTOCAD\FIGURES\UTC

SHEET: E2

PRE-FINAL DESIGN 95% DESIGN

02072F17.dwg

APPENDIX A

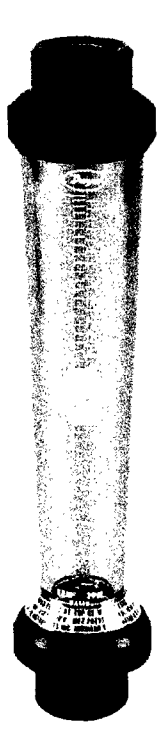
Equipment Manuals

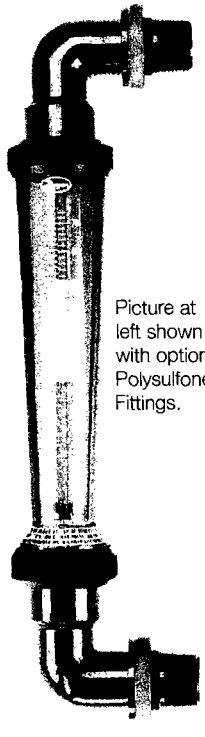
Rotometer
Solenoid Valve
Air Compressor
Pitot Tube
Air/Water Separator
SVE Blower
Granular Activated Carbon Vessels

ROTOMETER

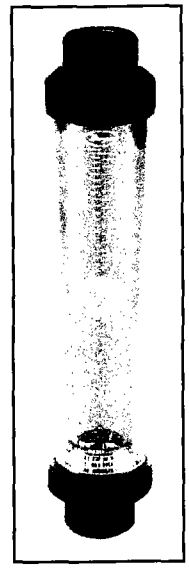
Series UV In-Line and Panel Mount Polysulfone Flowmeter

Specifications - Installation and Operating Instructions



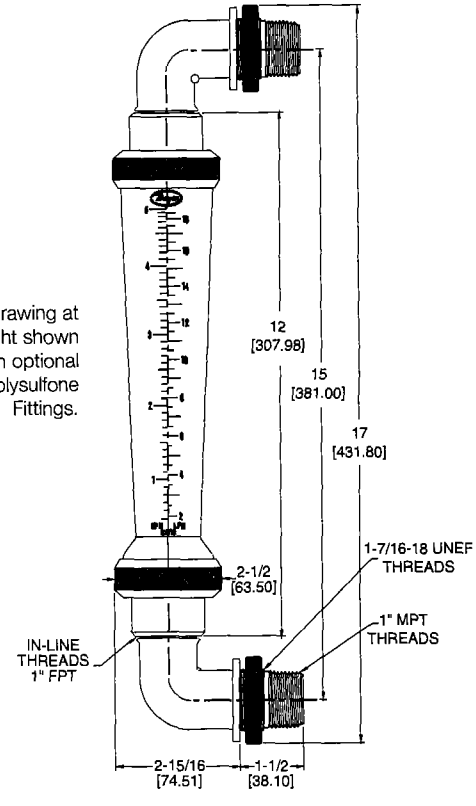


Picture at left shown with optional Polysulfone Fittings.



Optional Polycarbonate Shield

Drawing at right shown with optional Polysulfone Fittings.



The Series UV In-Line Polysulfone Flowmeter measures the flow of water, air, and other compatible media at temperatures up to 212°F (100°C) and pressures up to 150 psi (10.34 bar). This flowmeter's highly corrosion-resistant materials suit it ideally for use with de-ionized water and ultra-pure applications, including food processing, medical equipment and reverse osmosis water systems.

INSTALLATION

1. Select an indoor (only) location that is free from excess vibration, within the specified temperature limits, and away from direct sunlight. (Polysulfone is adversely affected by ultraviolet light.)

2. Remove hollow plastic shipping tube from inside flow body.

3. Handle carefully. Hand-tighten aluminum ring. O-Rings will seal if hand tightened only. Do not overtighten the adapters and fittings.

4. Install the flowmeter in an exact vertical plane, one that is in proper alignment with the existing plumbing. Use wall or other structural supports at the top and bottom of the unit. Do not allow the instrument to support the weight of pipes or tubing.

5. Use Teflon® tape thread sealant. Do not use pipe dope compounds, which can craze and crack the polysulfone housing. Hand tighten system pipe fitting to adaptor fitting. If additional torque is needed to seal pipe joint, use strap wrench on adaptor fitting. Maximum torque is 22 Foot - Pounds.

6. If using solvent-based glues like PVC cement, in the piping system, do so with the meter's body removed until glue has cured, then purge the system before re-installing. Do not solder brass fittings with the body installed, because the heat generated to solder the brass fittings will damage the flowmeter.

CAUTION: Ball valves and solenoid valves can have a "water cannon" effect on opening, creating pressure that exceeds the warrantied ratings and will damage the flowmeter.

SPECIFICATIONS

Service: Compatible liquids.
Wetted Materials: Polysulfone body, Viton® O-Rings and Virgin PTFE float.
Temperature Limits: 35 to 212°F (2 to 100°C); 35 to 130°F (2 to 54°C) for PVC Fitting Option.
Pressure Limit: 150 psi (10.34 bar).
Accuracy: ±2% Full Scale @ 70°F +/-2 F (21.1°C) and 14.7 psia (In line connection rating only).
Repeatability: +/-1% full scale @ 70+/-2°F (21.1°C) and 14.7 psia (In line connection rating only).
Process Connections: 1" female NPT. Optional 90° Polysulfone Elbow – 1" male NPT.
Scale Length: 6" (152.40) – 7" (177.80), depending on model.
Fitting Torque: Maximum 22 ft - lb.
Weight: 1 lb (457 g) (for 20 GPM range).

Teflon, Viton-Reg.TM E.I. du Pont de Nemours & Co.

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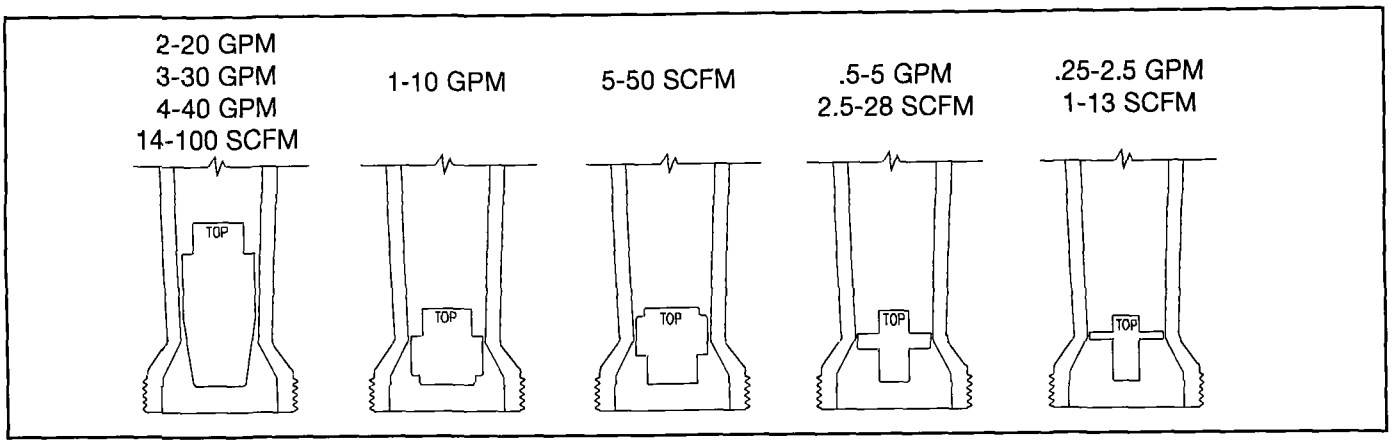

OPERATION AND MAINTENANCE

Once installed, the Series UV In-Line Polysulfone Flowmeter is self-operating and requires no maintenance other than an occasional cleaning with mild soap and a bottle brush. For this purpose, the unit has been designed so that its body can be removed quickly and easily while leaving all fittings intact.

When removing float for cleaning, note the floats "up" position. The float is a precision part and must be reassembled without adverse treatment, i.e. dropping, denting, and surface abrasion.

The standard technique for reading a Variable Area Flowmeter is to locate the highest point of greatest diameter on the float, and then align that with the theoretical center of the scale graduation. In the event that the float is not aligned with a grad, an extrapolation of the float location must be made by the operator as to its location between the two closest grads. The following are some sample floats shown with reference to the proper location to read the float.

Variable Area Flowmeters used for gases are typically labeled with the prefix "S" or "N", which represents "Standard" for English units or "Normal" for metric units. Use of this prefix designates that the flowmeter is calibrated to operate at a specific set of conditions, and deviation from those standard conditions will require correction for the calibration to be valid. In practice, the reading taken from the flowmeter scale must be corrected back to standard conditions to be used with the scale units. The correct location to measure the actual pressure and temperature is at the exit of the flowmeter, except under vacuum applications where they should be measured at the flowmeter inlet. The equation to correct for nonstandard operating conditions is as follows:

$$Q_2 = Q_1 \times \sqrt{\frac{P_1 \times T_2}{P_2 \times T_1}}$$

Where: Q_1 = Actual or Observed Flowmeter Reading
Q_2 = Standard Flow Corrected for Pressure and Temperature
P_1 = Actual Pressure (14.7 psia + Gage Pressure)
P_2 = Standard Pressure (14.7 psia, which is 0 psig)
T_1 = Actual Temperature (460 R + Temp °F)
T_2 = Standard Temperature (530 R, which is 70°F)

Example: A flowmeter with a scale of 10-100 SCFH Air. The float is sitting at the 60 grad on the flowmeter scale. Actual Pressure is measured at the exit of the meter as 5 psig. Actual Temperature is measured at the exit of the meter as 85°F.

$$Q_2 = 60.0 \times \sqrt{\frac{(14.7 + 5) \times 530}{14.7 \times (460 + 85)}}$$

Q_2 = 68.5 SCFH Air

Models and Ranges

Model Number	Range	Medium	Body	Fitting Material	Float
UV-0112	0.25-2.5 GPM (1-9.5 LPM)	Water	Polysulfone	Polysulfone	Virgin PTFE
UV-1112	0.5-5.0 GPM (2-19 LPM)	Water	Polysulfone	Polysulfone	Virgin PTFE
UV-2112	1.0-10.0 GPM (4-38 LPM)	Water	Polysulfone	Polysulfone	Virgin PTFE
UV-3112	2.0-20.00 GPM (8-76 LPM)	Water	Polysulfone	Polysulfone	Virgin PTFE
UV-4112	3.0-30.00 GPM (12-112 LPM)	Water	Polysulfone	Polysulfone	Virgin PTFE
UV-5112	4.0-40.00 GPM (20-150 LPM)	Water	Polysulfone	Polysulfone	Virgin PTFE
UV-A112	1-13 SCFM (30-370 LPM)	Air	Polysulfone	Polysulfone	Virgin PTFE
UV-B112	2.5-28 SCFM (70-780 LPM)	Air	Polysulfone	Polysulfone	Virgin PTFE
UV-C112	5-50 SCFM (70-1400 LPM)	Air	Polysulfone	Polysulfone	Virgin PTFE
UV-D112	14-100 SCFM (400-2800 LPM)	Air	Polysulfone	Polysulfone	Virgin PTFE

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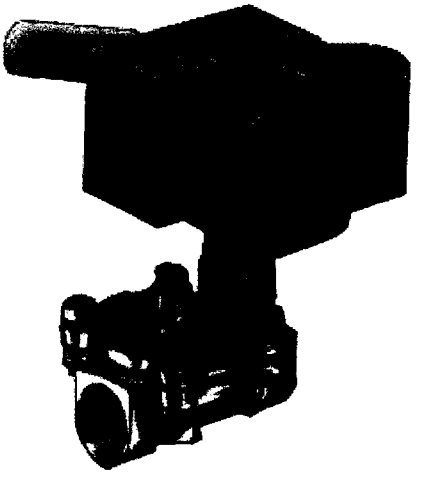


2 WAY
Manual Reset Solenoid Valves
Brass or Stainless Steel Bodies - ¾" to 2½"
N.P.T.

Constructions
The following movements are available:

Electrically Tripped: Manually move the lever to the latched position withe the solenoid de-energized. Trips when the solenoid is energized. Once tripped, the lever may be cycled causing the valve discs to open & close.

No Voltage Release: Manually move the lever to the latched position with the solenoid energized. Trips when solenoid is de-energized. Once tripped the lever may be cycled causing the valve discs to open & close.

Specifications
Solenoid Enclosures:

Optional Enclosures: Red-Hat -- Type 7 (C and D) Explosionproof which also meets Types 3 and 9. To order, add prefix "EF" to catalog number.

Electrical: Standard Voltages: 24, 120, 240, 480 volts, AC, 60 Hz (or 110, 220 volts, AC, 50 Hz)

6, 12, 24, 120, 240 volts, DC

Other voltages are available when required.

Note: 125 and 250 volts, DC, are battery voltages applied in power plants. Special valves are available to pilot control valves in power plants.

Valve Parts in Contact with Fluids:
Body -- Brass or Stainless Steel, as listed
Stem -- 303 s.s.
Springs -- 302 s.s.
Disc, Diaphragm, Seat & Seat Material -- as listed

Approvals: CSA certified. Meets shock and vibration ISA S71.03C2.

Ordering Information:
Important: We must have catalog number, voltage and Hertz, operating pressure and fluid handled. Use strainers with Solenoid Valves.

Valves listed in this series use the Red-Hat metal solenoid enclosure.

Coil: Continuous duty molded Class F or H, as listed.

Standard Enclosures:
Red-Hat -- Type 1 General Purpose Junction Box

Nominal Ambient Temperature Ranges: - 20°F to 104°F.

Pipe Size (ins.)	Orifice Size (ins.)	CV Flow Factor	Operating Pressure Differential (psi)			Max. Fluid Temp. °F		Standard Solenoid Enclosures Red-Hat - Type 1 Junction Box				Watt Rating/ Class of Coil Insulation	
								Latched Open		Latched Closed			
								No Voltage Release (closes when coil is de-energized)	Electrically Tripped (closes when coil is energized)	No Voltage Release (closes when coil is de-energized)	Electrically Tripped (closes when coil is energized)		
			Min.	Max. AC	Max. DC	AC	DC	Catalog Number	Catalog Number	Catalog Number	Catalog Number	AC	DC
Brass Body with Buna "N" Diaphragm for Air, Inert Gas, Water and Light Oil													
¾	¾	6.5	5	250	250	180	180	8025B201	8015B201	8025B214	8015B214	20/F	36.2/F
1	1	13	5	125	125	180	180	8025B202	8015B202	8025B215	8015B215	20/F	36.2/F
1 ¼	1 ¼	15	5	125	125	180	180	8025B203	8015B203	8025B216	8015B216	20/F	36.2/F
1 ½	1 ½	22.5	5	125	125	180	180	8025B204	8015B204	8025B217	8015B217	20/F	36.2/F
2	1 ¾	43	5	125	125	180	180	8025B205	8015B205	8025B218	8015B218	20/F	36.2/F
2 ½	1 ¾	45	5	125	125	180	180	8025B206	8015B206	8025B219	8015B219	20/F	36.2/F
Brass Body with PTFE Disc (Ethylene Propylene, FPM and PTFE seals) for Steam Service													
¾	¾	7.8	5	125	125	353	353	8025B207	8015B207	8025B220	8015B220	20/F	36.2/F
1	1	13.5	5	125	125	353	353	8025B208	8015B208	8025B221	8015B221	20/F	36.2/F
1 ¼	1 1/8	15	5	125	125	353	353	8025B209	8015B209	8025B222	8015B222	20/F	36.2/F
1 ½	1 ¼	22.5	5	125	125	353	353	8025B210	8015B210	8025B223	8015B223	20/F	36.2/F
Stainless Steel Body with PTFE Disc (FPM seals) for Corrosive Service													
½	3/8	3.2	5	250	250	350	350	8025B211	8015B211	8025B224	8015B224	20/F	36.2/F
¾	¾	7.8	5	250	250	350	350	8025B212	8015B212	8025B225	8015B225	20/F	36.2/F
1	1	11.2	5	125	125	350	350	8025B213	8015B213	8025B226	8015B226	20/F	36.2/F

AIR COMPRESSOR

Operating Instructions

CE

Rietschle Thomas
A Thomas Industries Company

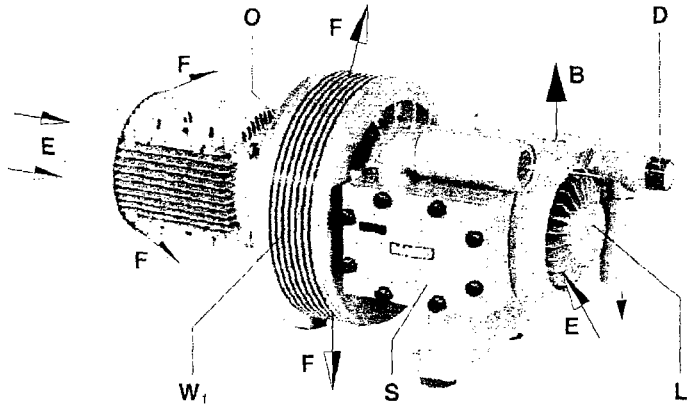
Compressors

DTB

MACRO

DTB 180
DTB 250
DTB 340
DTB 500

DTB (02)



❶

Pump Ranges

These operating instructions concern the following dry running rotary vane compressors: Models DTB 180 to DTB 500.

Version (02)	→	*cooling air exits through slots on the fan housing*	*see pictures* ❶ and ❸
Version (32)	→	*cooling air exits out of the spiral housing*	*see pictures* ❷
Version (62)	→	*cooling air exits through the compressed air aftercooler*	*see pictures* ❹

They have capacities of 175, 250, 350 and 510 m³/hr operating on 50 cycles. The pressure limits (bar) are indicated on the data plate (N). The pumping curves showing capacity against pressure can be found in data sheets:

D 367/1 → DTB 180 - DTB 500 (02) • D 367/2 → DTB 180 - DTB 500 (32)

Description

All models are complete with an inlet silencer and a threaded connection on the exhaust. All the air handled is filtered by a built-in micro-fine filter.

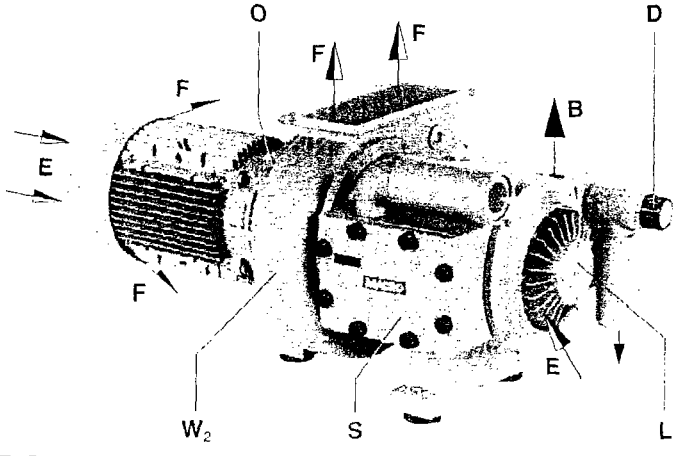
A high efficiency cooling fan, that pulls air in, is situated between the pump housing and the motor. On version (02) the fan is located in a fan housing (see pictures ❶ and ❸). The heated cooling air (F) is radially exhausted out of the fan housing (W_1). On version (32) the fan is located in a spiral housing (see picture ❷). In this case the heated cooling air (F) can be directed either upwards or to the side depending on the position of the spiral housing (W_2). It is also possible to connect ducting to the spiral housing so that the cooling air (F) can be transported away from the unit.

In addition version (62) has a compressed air aftercooler (T_1) through which the air is directed after the spiral housing (see picture ❹).

All the compressors are driven by a direct flanged three phase, standard TEFV motor via a pin and bush coupling.

Optional extras: As required, non return valve (ZRK), suction filter (ZAF), motor starter (ZMS), softstarter (ZAD), unloading valve (ZAE), various pressure gauges (ZDM) and acoustic enclosure (ZBX).

DTB (32)



❷

BE 367

1.6.2003

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Suitability

⚠ **The units DTB are suitable for use in the industrial field i.e. the protection equipment corresponds to EN DIN 294 table 4, for people aged 14 and above.**

The DTB compressors produce compressed air up to the maximum limits as shown on the data plate (N). They can be operated continuously.

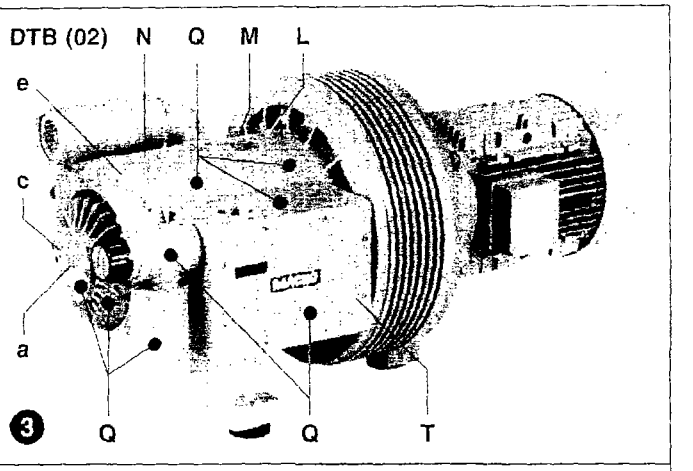
⚠ **The ambient and suction temperatures must be between 5 and 40° C. For temperatures outside this range please contact your supplier.**

These dry running compressors are suitable for use with air of a relative humidity of 30 to 90%.

⚠ **Dangerous mixtures (i.e. inflammable or explosive gases or vapours), extremely humid air, water vapour, aggressive gases or traces of oil and grease must not be handled.**

The standard versions may not be used in hazardous areas. Special versions with Ex-proof motors can be supplied.

⚠ **For all applications where an unplanned shut down of the compressor could possibly cause harm to persons or installations, then the corresponding safety backup system must be installed.**



Handling and Setting up

⚠ **Compressors that have reached operating temperature may have a surface temperature at position (Q) of more than 70° C. WARNING! Do Not Touch.** (see pictures ❸ and ❹)

The filter housing (S), exhaust box (T), housing cover (b) and greasing points (L) must all be easily accessible. For maintenance purposes we recommend a space of 0.4 m in front of the filter housing and housing cover. The cooling air entries (E) and the cooling air exits (F) must have a minimum distance of 20 cm from any obstruction. The discharged cooling air must not be re-circulated. If the cooling air exits from the spiral housing (W_2) via ducting, then care should be taken so that the passage of air is not obscured (see pictures ❶ to ❹).

The DTB compressors can only be operated reliably if they are installed horizontally.

⚠ **For installations that are higher than 1000 m above sea level there will be a loss in capacity. For further advice please contact your supplier.**

When installed on a solid base, these compressors do not require fixing down. If the compressors are installed on a base plate we would recommend fitting anti-vibration mounts. This range of compressors is almost vibration free in operation.

Installation (pictures ❶ to ❹)

⚠ **These compressors may not be operated without the standard pressure regulating and limiting valves fitted so that the maximum pressure is not exceeded (see data plate).**

The safety valve (optional) is a wearing item and must be changed after 10,000 h or at the latest 2 year operation.

For operating and installation follow any relevant national standards that are in operation.

1. Pressure connection at (B).

⚠ **Long and/or small bore pipework should be avoided as this tends to reduce the capacity of the compressor.**

2. The electrical data can be found on the data plate (N) or the motor data plate. The motors correspond to DIN/VDE 0530 and have IP 54 protection and insulation class B or F. The connection diagram can be found in the terminal box on the motor (unless a special plug connection is fitted). Check the electrical data of the motor for compatibility with your available supply (voltage, frequency, permissible current etc.).
3. Connect the motor via a motor starter. It is advisable to use thermal overload motor starters to protect the motor and wiring. All cabling used on starters should be secured with good quality cable clamps.
   We recommend that motor starters should be used that are fitted with a time delayed trip resulting from running beyond the amperage setting. When the unit is started cold, over-amperage may occur for a short time.

⚠ **The electrical installation may only be made by a qualified electrician under the observance of EN 60204. The main switch must be provided by the operator.**

Initial Operation (pictures ❶ and ❷)

⚠ **The desiccant bags in the filter housing (S) must be removed before initial start-up.**
Maximum number of starts per hour: 6 (DTB 180 / 250), 4 (DTB 340 / 500)

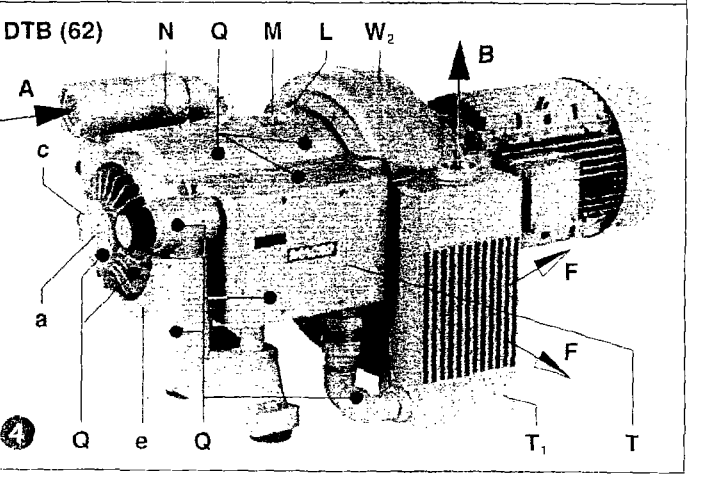
1. Initially switch the compressor on and off for a few seconds to check the direction of rotation against the direction arrow (O).
   Note: On this initial start the pressure pipework should not be connected. If the compressor runs backwards with the pipework connected a pressure could build up within the housing which could result in damaged rotor blades.
2. Connect the pressure pipe at (B).

⚠ **For pipe work longer than 3 m we recommend using non-return-valves (ZRK), to avoid reverse rotation when the units are switched off.**

3. The required pressure ranges can be adjusted by turning the pressure regulating valve (D) according to the symbols on the top of the regulating valve.

Potential risks for operating personnel

Noise Emission: The worst noise levels considering direction and intensity (sound power), measured according to DIN 45635 part 3 (as per 3. GSGV), are shown in the table at the back. When working permanently in the vicinity of an operating compressor we recommend wearing ear protection to avoid any damage to hearing.



Maintenance and Servicing

When maintaining these units and having such situations where personnel could be hurt by moving parts or by live electrical parts, the compressor must be isolated by totally disconnecting the electrical supply. It is imperative that the unit cannot be re-started during the maintenance operation.

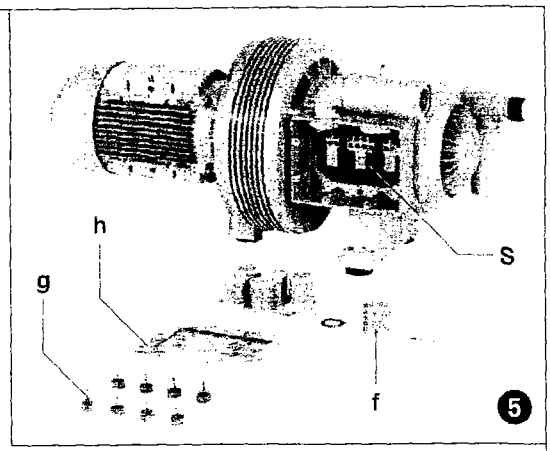
Do not maintain a compressor that is at its normal operating temperature as there is a danger from hot parts.

The pressure leading pipes must be ventilated before dismantling.

1. Lubrication (pictures ❶ to ❹)

The lubrication points are (L): lubrication periods are as follows, but the minimum is once a year:

Model		Operating hours 50 Hz	60 Hz	Grease every bearing
DTB	180	6.000	5.000	8 g
DTB	250	6.000	4.500	8 g
DTB	340	6.000	6.000	10 g
DTB	500	6.000	5.000	10 g



❺

Note! These greasing instructions are valid for operation at 20° C ambient temperature. At 40° C these should be reduced by 50 %.

We recommend the following grease types: Klüber PETAMO GY 193 or other equal greases (see label of recommended greases (M)).

2. Air filtration (picture ❻)

The capacity of the compressor may be reduced if the air inlet filters are not maintained correctly.

The filter cartridges (f) of the suction filter (S) have to be cleaned monthly and replaced once a year (under more extreme conditions, more regularly). Changing the filter: Loosen thumb screws (g). Take off filter cover (h) complete with gasket. Remove filter cartridges (f) and clean or exchange. Re-assemble in reverse order.

3. Blades (pictures ❸, ❹ and ❻)

Checking blades: The models DTB have 5 blades which have a low, but permanent, wear factor.

First check after 2,000 operating hours, thereafter every 500 operating hours.

Remove end cover (e). To remove the housing cover (b) from the housing the bolt (a) located in the centre of the bearing cover (c) should first be removed. To achieve this, one of the fixing bolts (s) from the housing cover should be screwed into the thread in the centre of the bearing cover (c). Remove the blades (d) and check. All blades must have a minimum height (X) of:

Model	X (minimum hight)
DTB 180	40 mm
DTB 250	52 mm
DTB 340	57 mm
DTB 500	57 mm

All blades must be changed at the same time.

Note! The DTB 500 has 2 blades per slot.

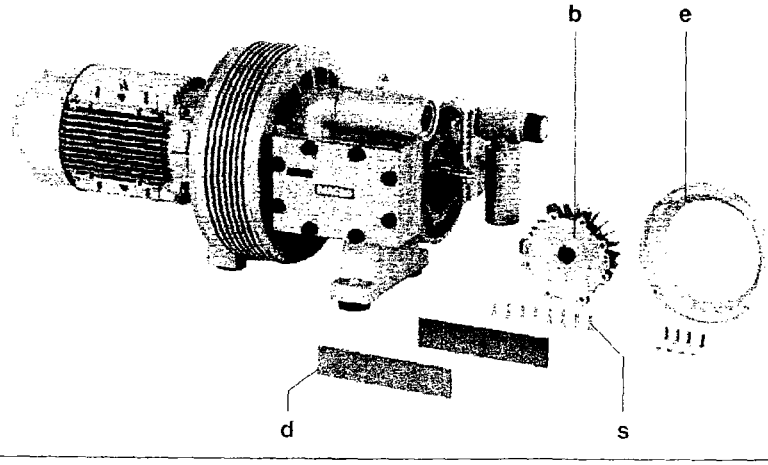
Changing blades: if you realise that the height (X) is reached, then the whole set of rotor blades (4 pieces) should be changed.

Before re-fitting the blades, blow out the housing and the rotor slots. Place the blades with the radius outwards (Y) so that the bevel is in the direction of rotation (O_1) and corresponds with the radius of the housing (Z).

Before re-fitting the housing cover (b), re-distribute the grease from the bearing cover (c) on to the appropriate bearing. It is important that the shaft end is completely clean so that no grease can enter the housing, as this could mix with carbon dust and give a viscous paste which would result in the blades becoming stuck in the rotor slots.

Note! Care should be taken that the bearing should not become contaminated.

When re-fitting the housing cover (b), tighten the bolts evenly so that the end cover fits correctly onto the fixing points. When the end cover is almost touching the housing we recommend moving the fan in both directions whilst further tightening the bolts. This can be achieved by removing the motor fan cover. This then ensures that the blades are sitting correctly in their slots and avoids any end damage. Re-fit the end cover (e).



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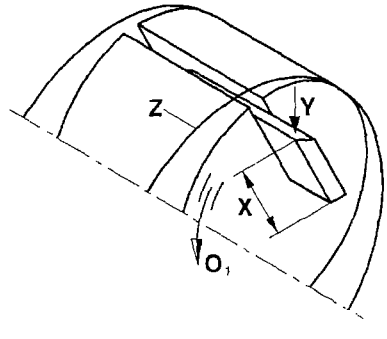


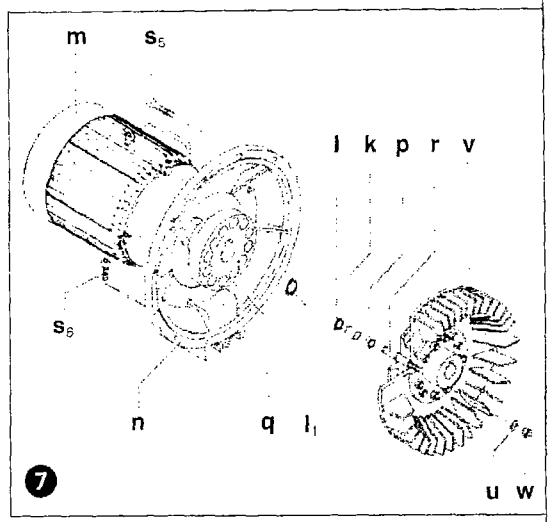
5. Coupling (picture ❼)

The coupling rubbers (k) are wearing parts and should be checked regularly. When the coupling rubbers are worn this can be detected by a knocking sound when the compressor is started.

⚠ **Defective coupling rubbers can cause extensive damage and even in some extreme cases break the rotor shaft.**

To check the coupling, stop the motor (m) and isolate. Remove the screws (s_5) on the motor flange (n). For motors secured by the feet, screws (s_6) should also be removed. Pull off the motor together with the motor side coupling half (q). If the coupling rubbers (k) are damaged, remove the circlips (l) from the coupling bolt (r) and exchange the coupling rubbers (k). Leave the spacer (p) in place, check the coupling bolts (r) for any wear and replace if necessary. To replace, remove the circlip (l_1), pull off the coupling and fan (v) complete from the pumpshaft, remove the nut (w) with washer (u) and exchange the coupling bolts.

Re-assemble in reverse order.



Trouble Shooting:

1. Motor starter cuts out compressor:

1.1 Check that the incoming voltage and frequency corresponds with the motor data plate.
1.2 Check the connections on the motor terminal block.
1.3 Incorrect setting on the motor starter.
1.4 Motor starter trips too fast.
Solution: Use a motor starter with a time delay trip (version as per IEC 947-4).
1.5 The regulating valve is dirty causing excess pressure.

2. Insufficient pressure capacity:

2.1 Inlet filters are obscured.
2.2 Pressure pipe work is too long or too small.
2.3 Leak on the compressor or on the system.
2.4 Blades are damaged.

3. Compressor does not reach overpressure:

3.1 Leak on the compressor or on the system.
3.2 Blades are damaged.
3.3 Motor rating selected was too small.

4. Compressor operates at an abnormally high temperature:

4.1 Ambient or suction temperature too high.
4.2 Cooling air flow is restricted.
4.3 Problem as per 1.5.

5. Unit emits abnormal noise:

5.1 The compressor cylinder is worn.
Solution: send your complete unit off for repair to the supplier or approved service agent.
5.2 Blades are damaged.

Appendix:

Repair on Site: For all repairs on site an electrician must disconnect the motor so that an accidental start of the unit cannot happen.
All engineers are recommended to consult the original manufacturer or one of the subsidiaries, agents or service agents. The address of the nearest repair workshop can be obtained from the manufacturer on application.
After a repair or before re-installation follow the instructions as shown under the headings "Installation and Initial Operation".

Lifting and Transport: To lift and transport the compressor the eye bolts on the housing and motor must be used. If an eye bolt is missing use suitably rated strops. The weight of the compressors is shown in the accompanying table.

Storage: DTB units must be stored in dry ambient conditions with normal humidity. We recommend for a relative humidity of over 80% that the compressor should be stored in a closed container with the appropriate drying agents.

Disposal: The wearing parts (as listed in the spare parts lists) should be disposed of with due regard to health and safety regulations.

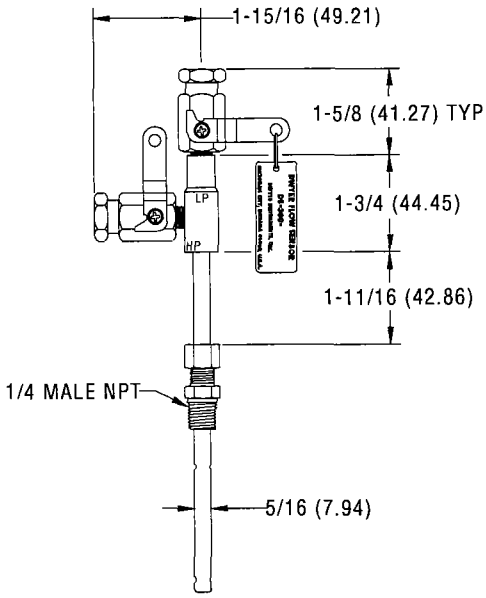
Spare parts lists: E 367/1 → DTB 180 - DTB 500 (02)
E 367/2 → DTB 180 - DTB 500 (32)

DTB			180	250	340	500
Noise level (max.) / Sound power*	dB(A)	50 Hz	80	80	84	85 / 95*
		60 Hz	81	81	86 / 97*	87 / 98*
Weight (max.)	kg	(02)	280	305	560	675
		(32)	285	310	570	685
		(62)	295	320	590	705
Length (max.)	mm	(02)	1294	1355	1432	1667
		(32)/(62)	1289	1350	1419	1662
Width	mm	(02)/(32)	568	568	704	714
		(62)	640	640	781	791
Height (max.)	mm	(02)	679	679	824	824
		(32)	751	751	911	911
		(62)	651	651	796	796

PITOT TUBE

Series DS-300 Flow Sensors

Installation and Operating Instructions Flow Calculations



Series DS-300 Flow Sensors are averaging pitot tubes that provide accurate, convenient flow rate sensing. When purchased with a Dwyer Capsuhelic® for liquid flow or Magnehelic® for air flow, differential pressure gage of appropriate range, the result is a flow-indicating system delivered off the shelf at an economical price. Series DS-300 Flow Sensors are designed to be inserted in the pipeline through a compression fitting and are furnished with instrument shut-off valves on both pressure connections. Valves are fitted with 1/8″ female NPT connections. Accessories include adapters with 1/4″ SAE 45° flared ends compatible with hoses supplied with the Model A-471 Portable Capsuhelic® kit. Standard valves are rated at 200°F (93.3°C). Where valves are not required, they can be omitted at reduced cost. Series DS-300 Flow Sensors are available for pipe sizes from 1″ to 10″.

INSPECTION

Inspect sensor upon receipt of shipment to be certain it is as ordered and not damaged. If damaged, contact carrier.

INSTALLATION

General - The sensing ports of the flow sensor must be correctly positioned for measurement accuracy. The instrument connections on the sensor indicate correct positioning. The side connection is for total or high pressure and should be pointed upstream. The top connection is for static or low pressure.

Location - The sensor should be installed in the flowing line with as much straight run of pipe upstream as possible. A rule of thumb is to allow 10 - 15 pipe diameters upstream and 5 downstream. The table below lists recommended up and down piping.

PRESSURE AND TEMPERATURE

Maximum: 200 psig (13.78 bar) at 200°F (93.3°C).

Upstream and Downstream Dimensions in Terms of Internal Diameter of Pipe*

Upstream Condition	Minimum Diameter of Straight Pipe		
	Upstream		Downstream
	In-Plane	Out of Plane	
One Elbow or Tee	7	9	5
Two 90° Bends in Same Plane	8	12	5
Two 90° Bends in Different Plane	18	24	5
Reducers or Expanders	8	8	5
All Valves**	24	24	5

* Values shown are recommended spacing, in terms of internal diameter for normal industrial metering requirements. For laboratory or high accuracy work, add 25% to values.

** Includes gate, globe, plug and other throttling valves that are only partially opened. If valve is to be fully open, use values for pipe size change. **CONTROL VALVES SHOULD BE LOCATED AFTER THE FLOW SENSOR.**

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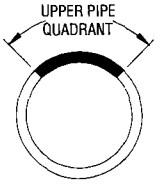
POSITION

Be certain there is sufficient clearance between the mounting position and other pipes, walls, structures, etc, so that the sensor can be inserted through the mounting unit once the mounting unit has been installed onto the pipe.

Flow sensors should be positioned to keep air out of the instrument connecting lines on liquid flows and condensate out of the lines on gas flows. The easiest way to assure this is to install the sensor into the pipe so that air will bleed into, or condensate will drain back to, the pipe.

For Air or Gas Flow

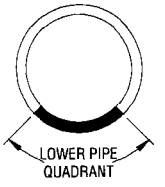
Install in upper quadrant of pipe



Condensate drains back to pipe

For Liquid or Steam Flow

Install in lower quadrant of pipe



Air bleeds back to pipe

INSTALLATION

1. When using an A-160 thred-o-let, weld it to the pipe wall. If replacing a DS-200 unit, an A-161 bushing (1/4˝ x 3/8˝) will be needed.

2. Drill through center of the thred-o-let into the pipe with a drill that is slightly larger than the flow sensor diameter.

3. Install the packing gland using proper pipe sealant. If the packing gland is disassembled, note that the tapered end of the ferrule goes into the fitting body.

4. Insert sensor until it bottoms against opposite wall of the pipe, then withdraw 1/16˝ to allow for thermal expansion.

5. *Tighten packing gland nut finger tight. Then tighten* nut with a wrench an additional 1-1/4 turns. Be sure to hold the sensor body with a second wrench to prevent the sensor from turning.

INSTRUMENT CONNECTION

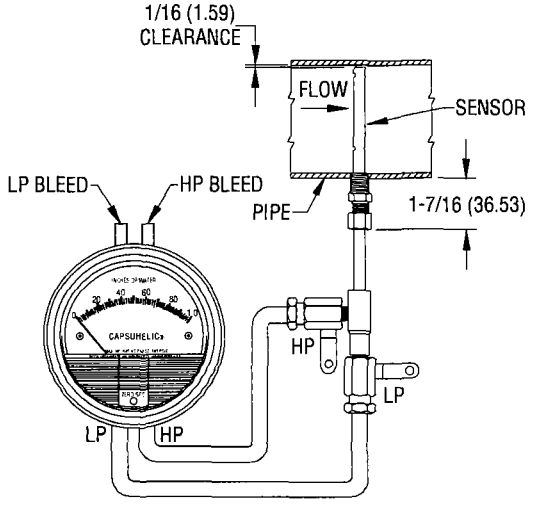
Connect the slide pressure tap to the high pressure port of the Magnehelic® (air only) or Capsuhelic® gage or transmitting instrument and the top connection to the low pressure port.

See the connection schematics below.

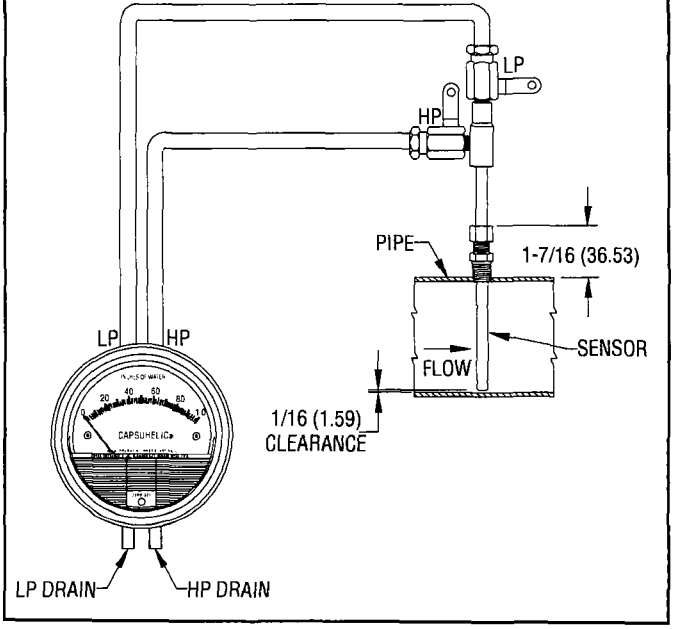
Bleed air from instrument piping on liquid flows. Drain any condensate from the instrument piping on air and gas flows.

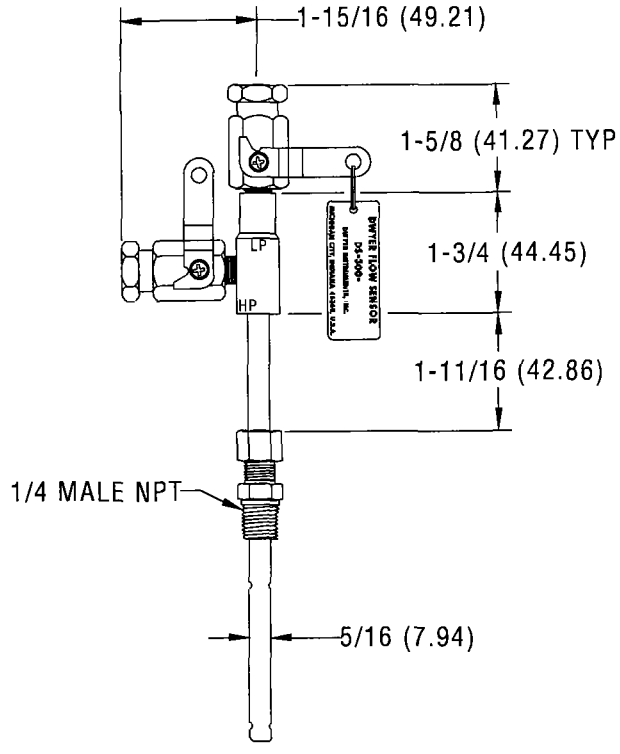
Open valves to instrument to place flow meter into service. For permanent installations, a 3-valve manifold is recommended to allow the gage to be zero checked without interrupting the flow. The Dwyer A-471 Portable Test Kit includes such a device.

Water Flow



Air or Gas Flow





Flow Calculations and Charts

The following information contains tables and equations for determining the differential pressure developed by the DS-300 Flow Sensor for various flow rates of water, steam, air or other gases in different pipe sizes.

This information can be used to prepare conversion charts to translate the differential pressure readings being sensed into the equivalent flow rate. When direct readout of flow is required, use this information to calculate the full flow differential pressure in order to specify the exact range of Dwyer Magnehelic® or Capsuhelic® gage required. Special ranges and calculations are available for these gages at minimal extra cost. See bulletins A-30 and F-41 for additional information on Magnehelic® and Capsuhelic® gages and DS-300 flow sensors.

For additional useful information on making flow calculations, the following service is recommended: Crane Valve Co. Technical Paper No. 410 "Flow of Fluids Through Valves, Fittings and Pipe." It is available from Crane Valve Company, www.cranevalve.com.

Using the appropriate differential pressure equation from Page 4 of this bulletin,calculate the differential pressure generated by the sensor under normal operating conditions of the system. Check the chart below to determine if this value is within the recommended operating range for the sensor. Note that the data in this chart is limited to standard conditions of air at 60°F (15.6°C) and 14.7 psia static line pressure or water at 70°F (21.1°C). To determine recommended operating ranges of other gases, liquids an/or operating conditions, consult factory.

Note: the column on the right side of the chart which defines velocity ranges to avoid. Continuous operation within these ranges can result in damage to the flow sensor caused by excess vibration.

Pipe Size (Schedule 40)	Flow Coefficient "K"	Operating Ranges Air @ 60°F & 14.7 psia (D/P in. W.C.)	Operating Ranges Water @ 70°F (D/P in. W.C.)	Velocity Ranges Not Recommended (Feet per Second)
1	0.52	1.10 to 186	4.00 to 675	146 to 220
1-1/4	0.58	1.15 to 157	4.18 to 568	113 to 170
1-1/2	0.58	0.38 to 115	1.36 to 417	96 to 144
2	0.64	0.75 to 75	2.72 to 271	71 to 108
2-1/2	0.62	1.72 to 53	6.22 to 193	56 to 85
3	0.67	0.39 to 35	1.43 to 127	42 to 64
4	0.67	0.28 to 34	1.02 to 123	28 to 43
6	0.71	0.64 to 11	2.31 to 40	15 to 23
8	0.67	0.10 to 10	0.37 to 37	9.5 to 15
10	0.70	0.17 to 22	0.60 to 79	6.4 to 10

FLOW EQUATIONS

1. Any Liquid

$$Q\ (GPM) = 5.668 \times K \times D^2 \times \sqrt{\Delta P / S_f}$$

2. Steam or Any Gas

$$Q\ (lb/Hr) = 359.1 \times K \times D^2 \times \sqrt{p \times \Delta P}$$

3. Any Gas

$$Q\ (SCFM) = 128.8 \times K \times D^2 \times \sqrt{\frac{P \times \Delta P}{(T + 460) \times S_s}}$$

DIFFERENTIAL PRESSURE EQUATIONS

1. Any Liquid

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_f}{K^2 \times D^4 \times 32.14}$$

2. Steam or Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2}{K^2 \times D^4 \times p \times 128{,}900}$$

3. Any Gas

$$\Delta P\ (in.\ WC) = \frac{Q^2 \times S_s \times (T + 460)}{K^2 \times D^4 \times P \times 16{,}590}$$

Technical Notations

The following notations apply:

ΔP = Differential pressure expressed in inches of water column
Q = Flow expressed in GPM, SCFM, or PPH as shown in equation
K = Flow coefficient— See values tabulated on Pg. 3.
D = Inside diameter of line size expressed in inches.

For square or rectangular ducts, use: $D = \sqrt{\frac{4 \times \text{Height} \times \text{Width}}{\pi}}$

P = Static Line pressure (psia)
T = Temperature in degrees Fahrenheit (plus 460 = °Rankine)
p = Density of medium in pounds per square foot
S_f = Sp Gr at flowing conditions
S_s = Sp Gr at 60°F (15.6°C)

SCFM TO ACFM EQUATION

$$SCFM = ACFM \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

$$ACFM = SCFM \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520}\right)$$

$$\text{POUNDS PER CUBIC FOOT STD.} = \text{POUNDS PER CUBIC FOOT ACT.} \times \left(\frac{14.7}{14.7 + PSIG}\right) \left(\frac{460 + °F}{520^*}\right)$$

$$\text{POUNDS PER CUBIC FOOT ACT.} = \text{POUNDS PER CUBIC FOOT STD.} \times \left(\frac{14.7 + PSIG}{14.7}\right) \left(\frac{520^*}{460 + °F}\right)$$

1 Cubic foot of air = 0.076 pounds per cubic foot at 60° F (15.6°C) and 14.7 psia.
* (520°= 460 + 60°) Std. Temp. Rankine

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AIR/WATER SEPARATOR

Filtration Accessories

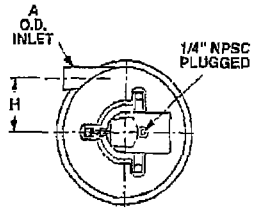
Blower Connection Key
NPT – American National Standard Taper Pipe Thread (Male)
NPSC – American National Standard Straight Pipe Thread for Coupling (Female)
SO – Slip On (Smooth – No Threads)

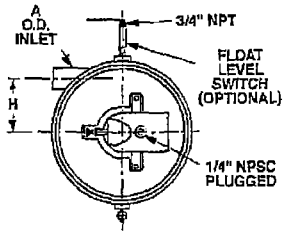
Moisture Separator™

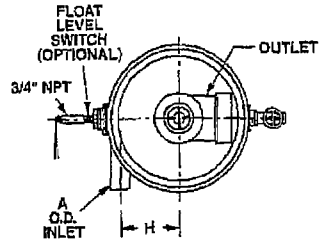
By separating and containing entrained liquids, Rotron's moisture separator helps protect our regenerative blowers and the end treatment system from corrosion and mineralization damage. Recommended for all soil vacuum extraction applications.

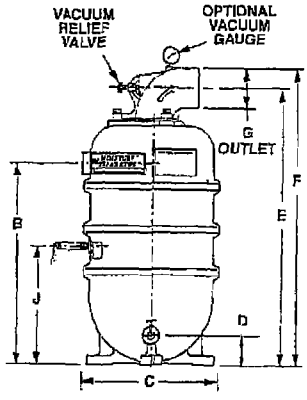
SPECIFICATIONS:

SEPARATION METHOD – High Efficiency Cyclonic
RELIEF VALVE MATERIAL – Brass & Stainless Steel
FLOAT MATERIAL – Copper
FLOAT SWITCH – SPDT, Explosion-proof
NEMA 7&9, 5 Amp max.

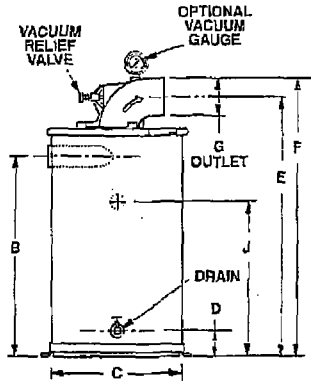




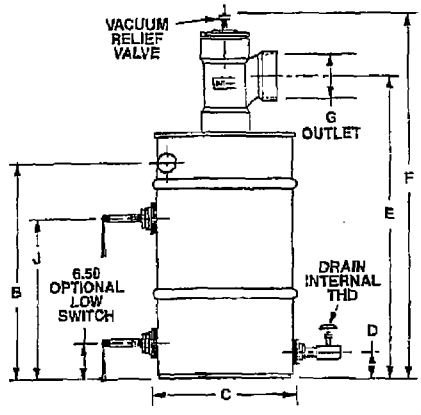




PLASTIC "P" DESIGN



METAL "D" DESIGN



METAL "B" DESIGN

Model	Part No.	CFM Max.	A Dia.	B	C Dia.	D	E	F	G Dia.	H	J Switch	Drain Internal THD	Shipping Weight
MS200PS	038518	200	2.38	22.46	16.00	3.25	31.05	33.30	4.50 OD	6.00	13.25	3/4" NPT	42 lb.
MS300PS	038520	300	2.88										
MS200DS	080086	200	2.00	22.12	16.75	2.75	27.92	30.17		6.56	12.62		
MS300DS	080087	300	2.50							6.81			
MS350BS	038357	350	3.25	28.00	23.00	4.00	37.25	39.50		9.75	17.50	1" NPT	82 lb.
MS500BS	080660	500											95 lb.
MS600BS	080659	600	4.00	27.00			37.37	54.50	6.63 ID	9.25			96 lb.
MS1000BS	038914	1000	6.00	31.00	27.00		47.32	51.70	8.62 OD	10.00	19.88		150 lb.

Models without float switch available. Metal MS200/300DS models are not the standard stocked, but are available.

Rev. 2/04

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2.0 Moisture Separator™ Specifications

2.1 DUTY

The moisture separator shall be designed for use in a soil vapor extraction system capable of continuous operation with a pressure drop of less than six inches of water at the rated flow of _____ SCFM. The separator shall be capable of operation under various inlet conditions ranging from a fine mist to slugs of water with high efficiency.

2.2 PRINCIPLE OF OPERATION

The moisture separator shall incorporate cyclonic separation to remove entrained water. The separator must protect against an overflow by fail safe mechanical means. An electrical switch or contact(s) alone is not an acceptable means of protection against overflow, but is a good backup.

2.3 CONSTRUCTION

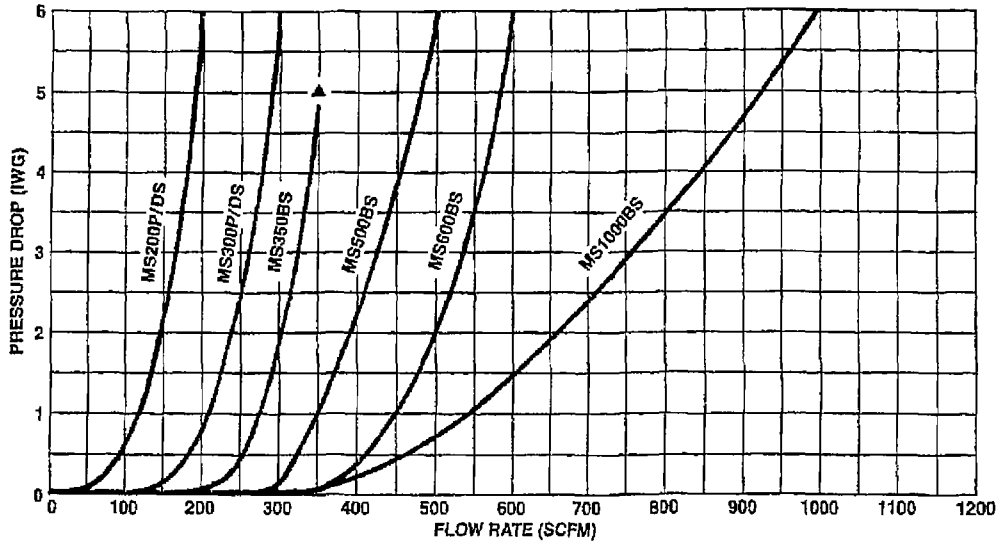
The body of the moisture separator shall be constructed of heavy wall plastic or heavy gauge cold rolled steel. The steel interior and exterior shall be epoxy (powder) coated to resist abrasion, corrosion, and chipping that might expose the surface. The inlet shall be tangentially located and welded to the body. The outlet port shall be constructed of PVC or cast aluminum alloy, flanged and sealed to the center of the top of the separator. The separator shall incorporate a non-sparking copper float ball and an adjustable relief valve to protect against overflow and overheating the blower.

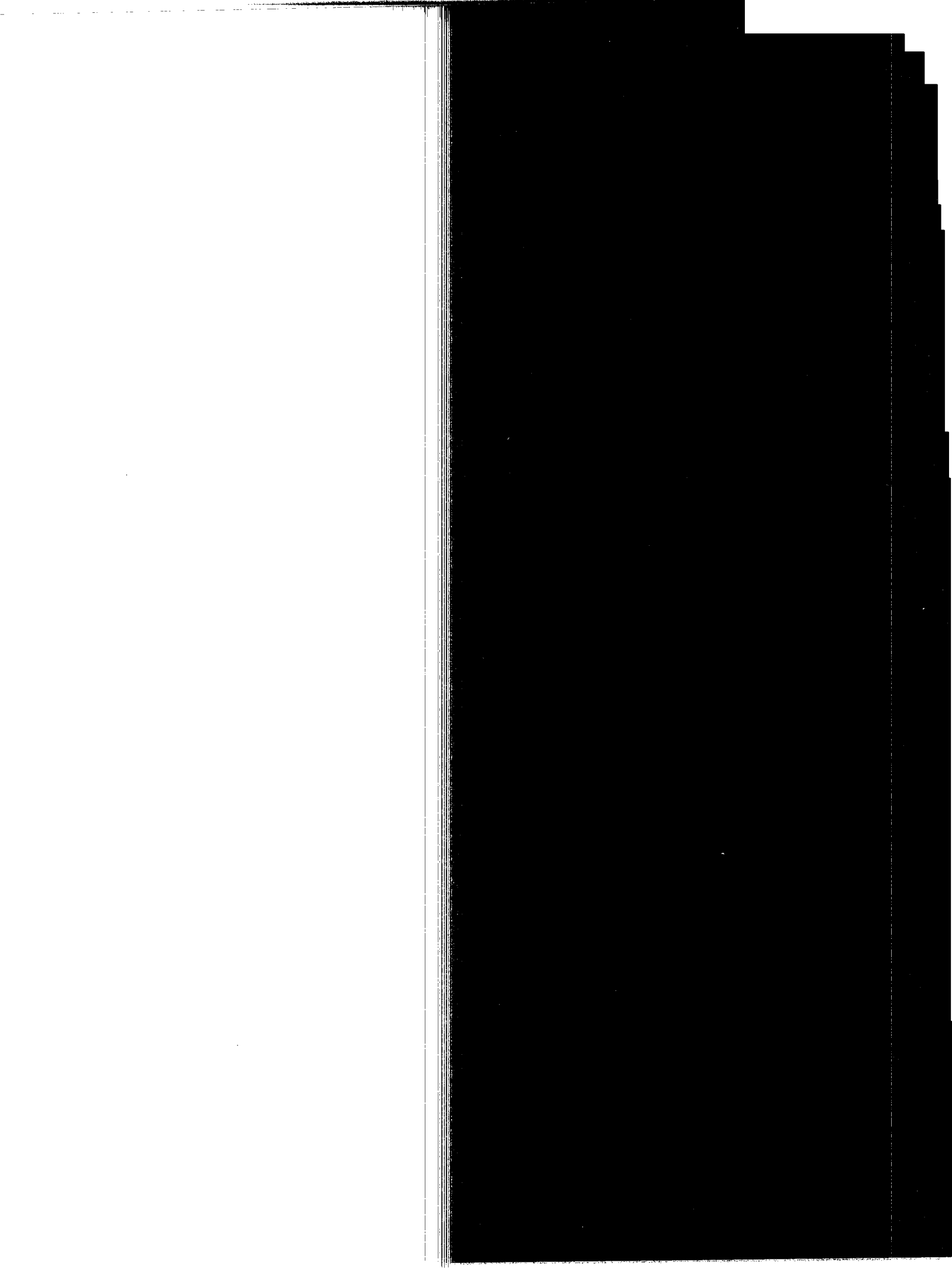
2.4 CAPACITY AND DIMENSIONS

The moisture separator must have a liquid capacity of _____ gallons. The inlet shall be _____ inch OD slip-on type. The outlet shall be _____ inch OD slip-on type.

For DR/EN/CP Blower Model	Selector Moisture Separator Model	Liquid-holding Capacity (gallons)	Inlet (OD)	Outlet	Max Vacuum Allowed (IHg)
404 454 505 513	MS200PS	7	2.38	4.5" OD	12
523 555 623 823	MS200DS	10	2.0		22
656	MS300PS	7	2.88		12
6 707	MS300DS	10	2.5		22
808	MS350BS	40	3.25	6.63" ID	
858 1223	MS500BS				
909	MS600BS		4.0"		
979 14	MS1000BS	65	6.0"	8.62" OD	

2.5 PRESSURE DROP





SVE BLOWER

Operating Instructions

CE

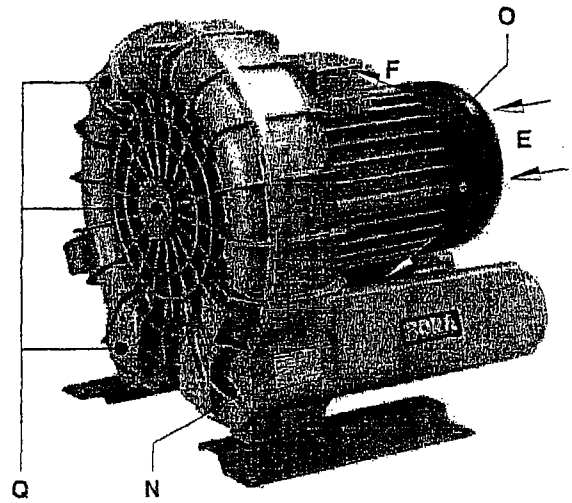
Rietschle Thomas
A Thomas Industries Company

Side channel vacuum pumps / Side channel compressors

SAP

BORA

SAP 50
SAP 90
SAP 110
SAP 150
SAP 180
SAP 220
SAP 300
SAP 380
SAP 450
SAP 530
SAP 710
SAP 1060
SAP 1500



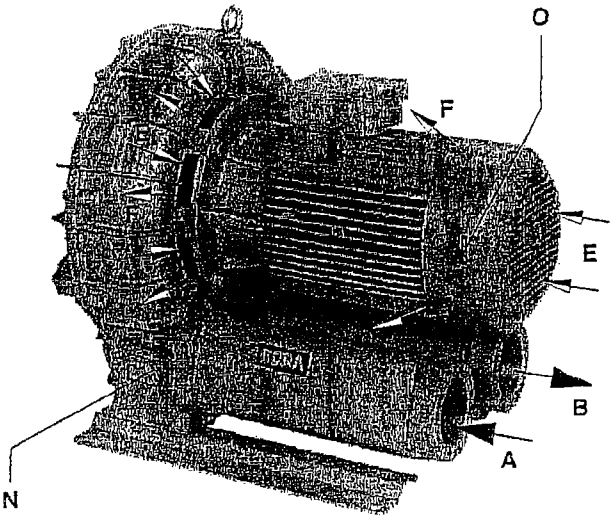
1

Pump ranges

These operating instructions concern the following side channel vacuum pumps and compressors: SAP
The performance curves showing capacity against vacuum or pressure can be seen in data sheets D 545/1, D 545/2 and D 545/3 or D 645/1, D 645/2 and D 645/3.

Description

All SAP models work according to the dynamic compression principle utilising a non contact rotating impellor. They have a built-in motor. A high efficiency double-flow impellor is fitted on to the motorshaft. Models up to SAP / 4 kW (picture 1) use the motor fan for cooling. Models SAP / 5.5 kW and larger (picture 2) have an additional cooling fan situated between the motor and blower housing.
Air inlet and outlets have built-in silencers with the addition of a mesh disc on the suction silencer to protect the unit from particles larger than 5 mm. Both the inlet and outlet have an inside connection thread corresponding to DIN ISO 228.
Versions of the SAP have on the suction side a solenoid valve and on the pressure side different connection flanges.
All the parts are made from a special aluminium alloy except for the motor rotor, stator and shaft.
Optional extras: As required, vacuum or pressure limiting valve, non-return valve, suction filter, motor starter, vacuum/ pressure change over valve.
Special versions: anti corrosive internal coating, gas tight version.



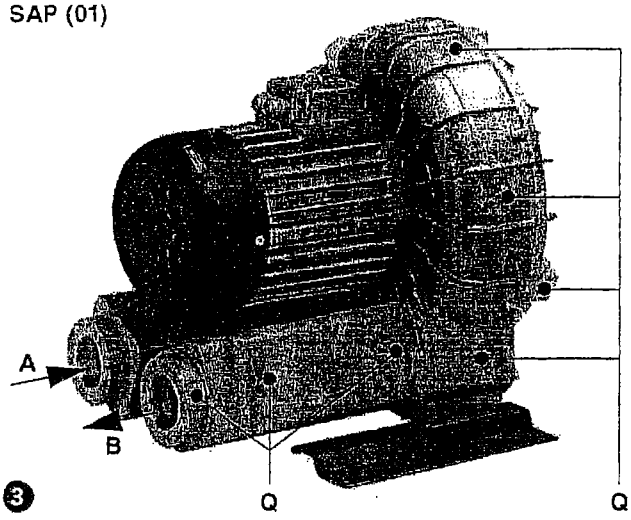
2

BE 545
1.11.2003

Rietschle Thomas GmbH + Co. KG
Postfach 1260
79642 SCHOPFHEIM
GERMANY
Fon 07622/392-0
Fax 07622/392300
e-mail:
info.sch@rtpumps.com
www.rtpumps.com/sch

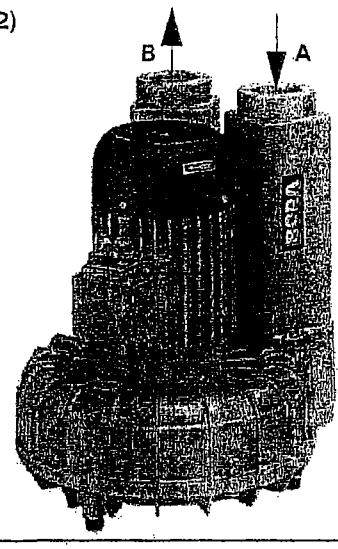
Rietschle Thomas UK
Bellingham Way
NEW HYTHE
KENT ME20 6XS
UNITED KINGDOM
Fon 01622/716816
Fax. 01622/715115
e-mail:
ukinfo@rtpumps.com
http://www.rtpumps.co.uk

SAP (01)



3

SAP (02)



Suitability

⚠ **The units SAP are suitable for use in the industrial field i.e. the protection equipments corresponds to EN DIN 294 table 4, for people aged 14 and above.**

SAP models can be operated as vacuum pumps or compressors. They are suitable for use with air of a relative humidity up to 90 % but not aggressive gases. Gas tight versions are avaliable. The tightness of each unit depends on the shaft seal. The shaft seal lifetime relates directly to the operating conditions.

⚠ **Dangerous mixtures (i.e. inflammable or explosive gases or vapours), water vapour or aggressive gases must not be handled.**

Handling of inflammable or aggressive gases and vapours is only possible with special versions, if the safety instructions XE 1 are noted. Operation in potentially explosive areas is not permissible.

⚠ **The ambient and suction temperatures must be between 5 and 40°C. For temperatures outside this range please contact your supplier.**

For less aggressive media an internal protection coating can be utilised.

The maximum permissible pressure difference for vacuum or pressure depends upon the motor rating. This is indicated on the data plate (N) and is shown in the data sheet for standard voltages and frequency:

SAP 50, SAP 90, SAP 110, SAP 150, SAP 180 see data sheet D 545/1 or D 645/1

SAP 220, SAP 300, SAP 380, SAP 450 see data sheet D 545/2 or D 645/2

SAP 530, SAP 710, SAP 1060, SAP 1500 see data sheet D 545/3 or D 645/3

Operating above these pressure differences the motor would be overloaded. As well as considering the maximum allowable pressure difference, the amperage should also be checked against the data plate (N).

The loading of each unit depends on the specific gravity of the gas handled. Therefore when handling gases other than air, there are other pressure difference limits to be considered. Please contact the supplier for further advice.

If it is possible for the flow to be throttled more than the allowed limits, then the use of vacuum or pressure limitation valves (optional extras) should be considered.

The maximum permissible internal pressure is 3.5 bar(abs). With this pressure the performance is reduced.

⚠ **For all applications where an unplanned shut down of the blower could possibly cause harm to persons or installations, the corresponding safety backup system must be installed.**

Handling and Setting up (pictures ①, ② and ④)

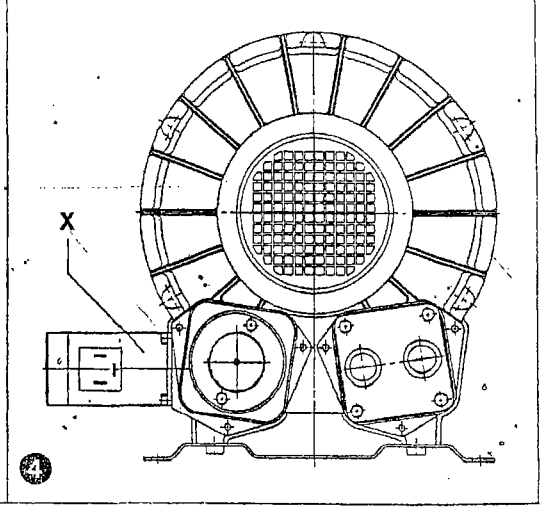
⚠ **Pumps that have reached operating temperature may have a surface temperature at position (Q) of more than 70°C. WARNING! Do Not Touch.**

The blower, especially when the units are built-in, the cooling air entries (E) and the cooling air exits (F) must have a minimum distance of 10 cm from any obstruction. The discharged cooling air must not be re-circulated.

SAP units can be operated in different positions.

SAP (01) models can be installed on a solid floor without bolting down. When installing SAP (02) models, i.e. motor vertically upwards, you must secure against torque reaction on start-up. When fitting onto framework we recommend using anti-vibration mounts.

⚠ **For installations that are higher than 1000 m above sea level there will be a loss in capacity. For further advice please contact your supplier.**



4

Installation (pictures ❶, ❷ and ❸)

⚠ **For operating and installation follow any relevant national standards that are in operation.**

1. When on vacuum operation connect the suction pipe at (A) and when on pressure operation connect the pressure pipe at (B).

⚠ **Long and/or small bore pipework should be avoided as this tends to reduce the capacity of the blower.**

If alternate vacuum or pressure is required, a changeover valve (ZWS) can be fitted (optional extra). In this case there is only one connection for vacuum or pressure operation.

2. The electrical data can be found on the data plate (N) or the motor data plate. The motors correspond to DIN/VDE 0530 and have IP 55 protection and insulation class F. The connection diagram can be found in the motor terminal box (unless a special plug connection is fitted). Check the electrical data of the motor for compatibility with your available supply (voltage, frequency, permissible current etc.).
3. Connect the motor via a motor starter. It is advisable to use thermal overload motor starters to protect the motor and wiring. All cabling used on starters should be secured with good quality cable clamps.
   We recommend that motor starters should be used that are fitted with a time delayed trip resulting from running beyond the amperage setting. When the unit is started cold overamperage may occur for a short time.
   When using a solenoid valve or changeover valve (ZWS) the solenoid (X) must also be connected. The voltage information on the solenoid should also be checked.

⚠ **The electrical installation may only be made by a qualified electrician under the observance of EN 60204. The main switch must be provided by the operator.**

Initial Operation (pictures ❶ and ❷)

⚠ **Maximum number of starts per hour: 10**

1. Initially switch the pump on and off for a few seconds to check the direction of rotation against the direction arrow (O).
2. When installed on the application and under the highest possible load conditions, the pressure differences of the unit may not be higher than the max. allowable pressure differences shown on the data plate (N).
   Note: If these values are exceeded when the unit is running on normal operating temperature an unloading of the unit is required by utilising limitation valves ZBS, ZUV or ZBD (optional extra).
3. A comparison of the measured current amperage with the max. current amperage on the data plate (N) is not advisable, because the current amperage depends on the voltage.

Potential risks for operating personnel

Noise Emission: The worst noise levels considering direction and intensity (sound power), measured according to DIN 45635 part 13 (as per 3. GSGV), are shown in the table at the back. When working permanently in the vicinity of an operating unit we recommend wearing ear protection to avoid any damage to hearing.

Maintenance and Servicing

⚠ **When maintaining these units and where a situation exists where personnel could be hurt by moving parts or by live electrical parts the blower must be isolated by totally disconnecting the electrical supply. It is imperative that the unit cannot be re-started during the maintenance operation.**

Do not maintain a blower that is at its normal operating temperature as there is a danger from hot parts.

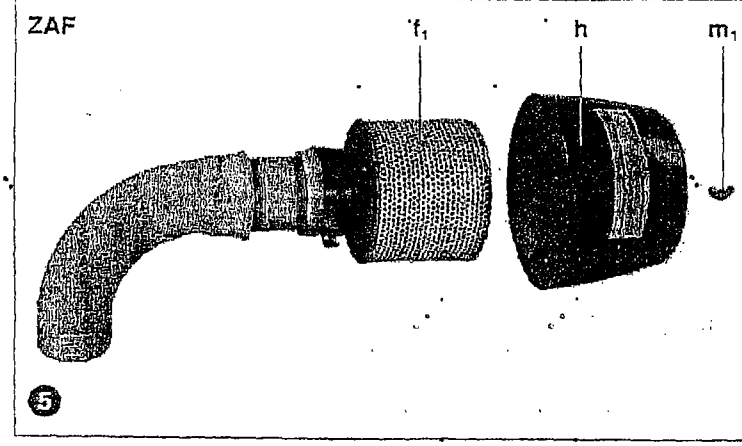
The pressure leading pipes must be ventilated before dismantling.

These side channel vacuum pumps and compressors need no maintenance apart from filtration.

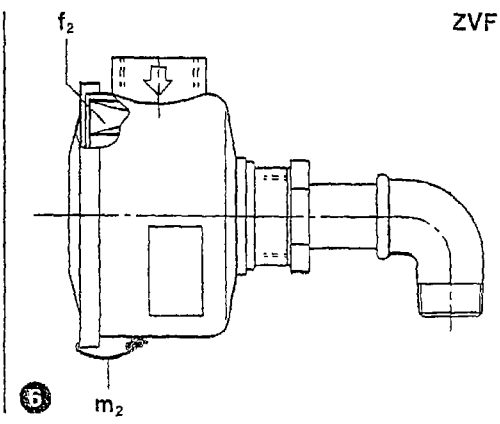
⚠ **The capacity of the blower can be reduced if the air inlet filters are not maintained correctly.**

1. Mesh disc on the silencing housing:
   Cleaning of this is possible through the opening (A) and (B).
2. Additional filter (optional extra):
   The suction filter (ZAF) should be cleaned every 250 operating hours and changed every 3000 operating hours. Changing the filter: unscrew wing nut (m_1). Remove filter cover (h) and filter cartridge (f_1). The filter cartridge can be cleaned by knocking out by hand or by using compressed air. Replace the filter cartridge if necessary. Re-assemble in reverse order (see picture ❺).
   The filter cartridge (f_2) of the vacuum tight suction filter (ZVF) must be cleaned regularly, again depending upon the amount of contamination. Cleaning can be achieved by washing or by blowing out with compressed air. Replace the filter cartridge if necessary. The cartridge (f_2) can be removed completely by undoing the relevant retaining clips (m_2) (see picture ❻).
3. Bearings:
   The units have bearings that are greased for life and require no maintenance.

⚠ **Handling of inflammable or aggressive gases and vapours is only possible with special versions, if the safety instructions XE 1 are noted.**



❺



❻

Trouble Shooting:

1. **Blower does not reach operating speed when starting:**
1.1 Check that the incoming voltage and frequency corresponds with the motor data plate.
1.2 Check the connections on the motor terminal block.

2. **Motor starter cuts out blower:**
2.1 Problem as per 1.1 and 1.2.
2.2 Incorrect setting on the motor starter.
2.3 Motor starter trips too fast.
Solution: Use a motor starter with a time delay trip (version as per IEC 947-4).
2.4 Blower is overloaded, i.e. pressure difference is too high.
Solution: Increase the inlet or outlet diameter of the application, on pipework increase the diameter of the pipework, avoid restrictions in the line. Limit the pressure difference by limitation valves (optional extra).
2.5 Motor rating selected was too small.
Solution: If available use a blower with the next motor size (exchange of the motor only is not possible).

3. **Required pressure difference cannot be achieved:**
3.1 Blower or motor rating selected, was too small.
3.2 Filters are contaminated.
3.3 Pressure loss into pipework too high,
Solution: Use bigger pipe diameter, avoid restrictions.
3.4 Leaks on the system.

4. **Blower operates at an abnormally high temperature:**
4.1 Ambient or suction temperature is too hot.
4.2 Pressure difference is higher than permitted.
4.3 Cooling air flow is restricted.

5. **Exhaust noise (vacuum pump) or suction noise (compressor) are unacceptable:**
Solution: Use an additional silencer ZGD (optional extra).

6. **Change solenoid valve or change over valve ZWS (accessory) does not work:**
6.1 Check that the incoming voltage and frequency correspond with the information on the solenoid.
6.2 Change over valve is contaminated.
Solution: Dismantle and clean.

Appendix:

Repair on Site: For all repairs on site an electrician must disconnect the motor so that an accidental start of the unit cannot happen.
All engineers are recommended to consult the original manufacturer or one of the subsidiaries, agents or service agents. The address of the nearest repair workshop can be obtained from the manufacturer on application.
After a repair or before re-installation follow the instructions as shown under the headings "installation and Initial Operation".

Lifting and Transport: To lift and transport units SAP 180 to SAP 1500 the eye bolt on the pump must be used.
The weight of the blowers are shown in the accompanying table.

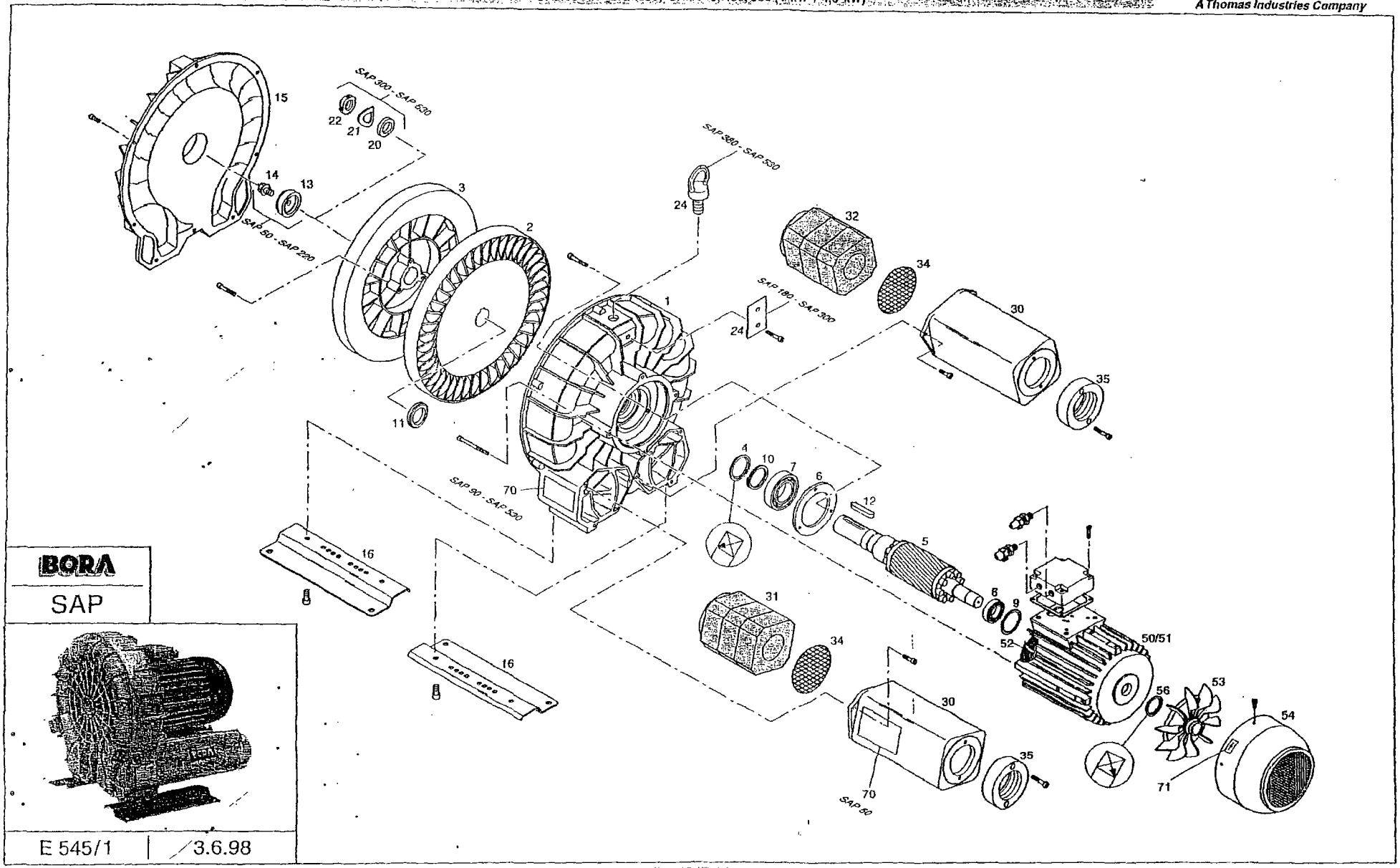
Storage: SAP units must be stored in dry ambient conditions with normal humidity. We recommend for a relative humidity of over 80% that the pump units should be stored in a closed container with the appropriate drying agents.

Disposal: The wearing parts (as listed in the spare parts lists) should be disposed of with due regard to health and safety regulations.

Spare parts lists: E 545/1 • SAP 50 —> SAP 300; SAP 380, 450, 530 (4 kW + 4,8 kW)
E 545/2 • SAP 380, 450, 530 (5,5 kW –> 9 kW); SAP 710; SAP 1060; SAP 1500

SAP			50	90	110	150	180	220	300	380	450	530	710	1060	1500
Noise level (max.)	dB(A)	50 Hz	75	81	81	87	86	88	87	86	90	93,5	92,5	99	99
		60 Hz	77	81	82	87	87	89,5	91	86	90	92	94	99	100
Sound power	dB(A)	50 Hz	-	-	-	91	94	98	95	92	99	100	99	108	108
		60 Hz	-	-	-	92	94	99	100	92	99	100	101	108	108
Weight (max.)		kg	16	17	24,5	24,5	34	42	53	58	95	88	125	200	201
Length (max.)		mm	328	340	362	369	411	429	464	490	608	634	664	764	790
Width		mm	234	251	282	282	332	370	386	432	450	471	534	534	534
Height		mm	267	297	322	322	381	414	443	486	525	561	617	639	606

Rietschle Thomas
A Thomas Industries Company



BORA

SAP

E 545/1 | 3.6.98

		Verdichterteile	Compressor part	Eléments compresseur	Parti di compressore
1		Gebläsegehäuse	Blower housing	Corps turbine	Corpo soffiante
2		Laufrad' A	Impellor' A	Roue à aube' A	Girante' A
3		Laufrad' B	Impellor' B	Roue à aube' B	Girante' B
4	D	Wellendichtring	Shaft seal	Joint d'arbre	Anello di tenuta sull' albero
5		Motorwelle	Motor shaft	Arbre moteur	Albero motore
6		Lagerdeckel	Bearing cover	Couvercle pallier	Coperchio cuscinetti
7	V	Rillenkugellager SAP 50 - 450 → 1 Teil SAP 530 (4 kW) → 2 Teile	Deep groove ball bearing SAP 50 - 450 → 1 part SAP 530 (4 kW) → 2 parts	Roulement aiguille SAP 50 - 450 → 1 elément SAP 530 (4 kW) → 2 éléments	Cuscinetto a sfera SAP 50 - 450 → 1 parte SAP 530 (4 kW) → 2 parti
8	V	Rillenkugellager	Deep groove ball bearing	Roulement aiguille	Cuscinetto a sfera
9	V	Ausgleichsscheibe	Tolerance shim	Rondelle de rappel	Anello elastico
10	V	Sicherungsring	Lock ring	Circlip	Anello di sicurezza
11		Distanzscheibe	Spacer shim	Rondelle entre-toise	Disco distanziatore
12		Passfeder	Key	Clavette	Chiavetta
15		Gebläsedeckel	Blower cover	Couvercle turbine	Coperchio soffiante
16		Fuß SAP 50 - 150 → 1 Teil SAP 180 - 530 → 2 Teile	Foot SAP 50 - 150 → 1 part SAP 180 - 530 → 2 parts	Socle SAP 50 - 150 → 1 elément SAP 180-530 → 2 éléments	Piedistallo SAP 50 - 150 → 1 parte SAP 180 - 530 → 2 parti
		SAP 50 - SAP 220			
13		Scheibe	Disc	Rondelle	Disco
14		Sechskantschraube Verbusripp	Hexagon head screw	Vis six pans	Vite con testa esagonale
		SAP 300 - SAP 530			
20		Scheibe	Disc	Rondelle	Disco
21		Federscheibe	Spring shim	Rondelle ressort	Disco a molla
22		Wellenmutter	Shaft nut	Ecrou d'arbre	Ghiera
		SAP 180 - SAP 300			
24		Transportlasche	Transport flap	Laiguette de transport	Golfare
		SAP 380 - SAP 530			
24		Ringschraube	Lifting eye	Anneau de levage	Golfare

		Schalldämpfer	Silencer	Silencieux	Silenziatore
30		Schalldämpfergehäuse	Silencer housing	Carter silencieux	Carcassa silenziatore
31		Schalldämpfereinsatz 'Saugseite	Silencer insert 'Vacuum side	Elément silencieux 'Côté aspiration	Elemento silenziatore 'Lato aspirazione
32		Schalldämpfereinsatz 'Druckseite	Silencer insert 'Pressure side	Elément silencieux 'Côte surpression	Elemento silenziatore 'Lato pressione
34		Siebscheibe	Mesh disc	Disque crépine	Disco reticella
35		Anschlussplatte	Connection plate	Plaque raccordement	Piastra di collegamento
		Antrieb	**Drive**	**Entraînement**	**Azionamento**
50		Motorgehäuse komplett	Motor housing complete	Enveloppe et stator	Carcassa motore completa
51		Motorgehäuse (Einzelteil)	Motor housing (single part)	Enveloppe stator	Carcassa motore (singola)
52		Stator	Stator	Stator	Statore
53		Ventilator mit Klemmring	Fan with clamping ring	Ventilateur avec bague de serrage	Ventilatore con anello di serraggio
54		Lüfterhaube	Fan cover	Capot ventilateur	Cofano del ventilatore
56	D	Wellendichtring	Shaft seal	Joint d'arbre	Anello di tenuta sull' albero
		Schilder	**Labels**	**Plaques signalétiques**	**Targhette**
70		Datenschild	Data plate	Etiquette caractéristique	Targhetta dati
71		Pfeilschild	Direction arrow	Sens de rotation	Freccia senso di rotazione

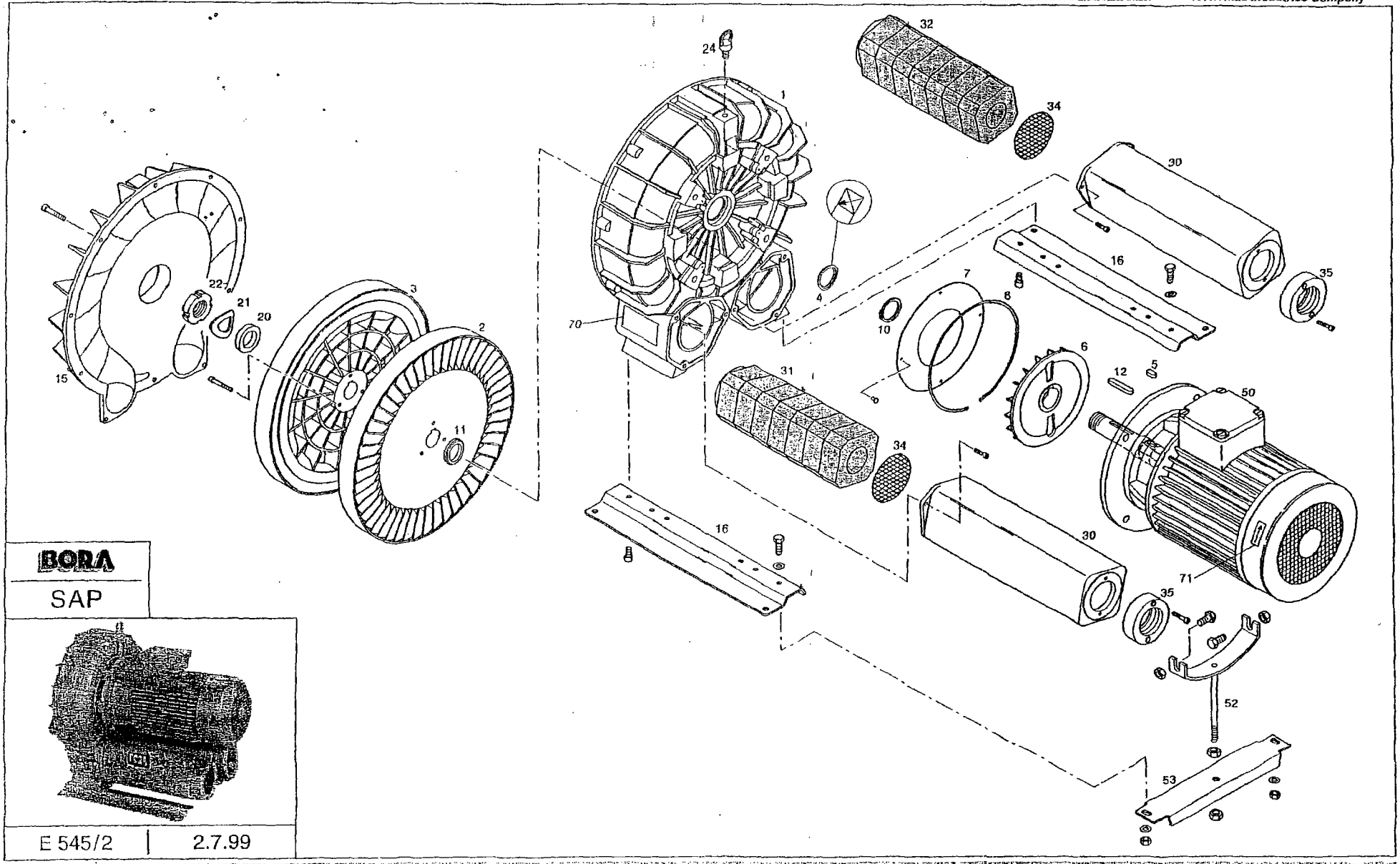
Bei Bestellungen folgendes angeben: Typ, Fabrikations-Nr., Positions-Nr., Motor (kW, V, Hz)
To order please indicate: model, serial-no., item-no., motor (kW, V, Hz)
En cas de commande préciser: type d'appareil, no. de position des pièces, moteur (kW, V, Hz)
Nell'ordine indicare: tipo, numero di matricola, numero di posizione dei ricambi, motore (kW, V, Hz)

V = Verschleißteile
V = Wearing parts
V = Pièces d'usure
V = Parti usurabili

D = Dichtungen
D = Seals
D = Joints
D = Guarnizioni

Rietschle Thomas GmbH + Co. KG
Postfach 1260 • 79642 SCHOPFHEIM / GERMANY
Fon 07622 / 392-0 • Fax 07622 / 392300
e-mail: info.sch@rtpumps.com

Rietschle Thomas
A Thomas Industries Company



BORA

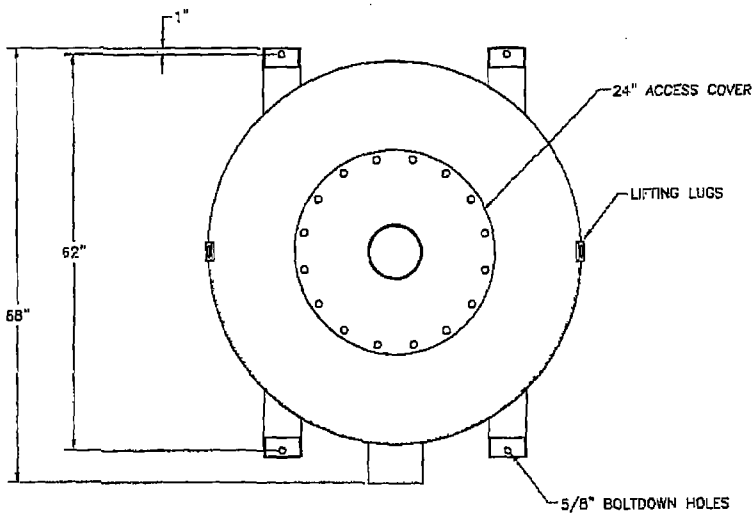
SAP

E 545/2 | 2.7.99

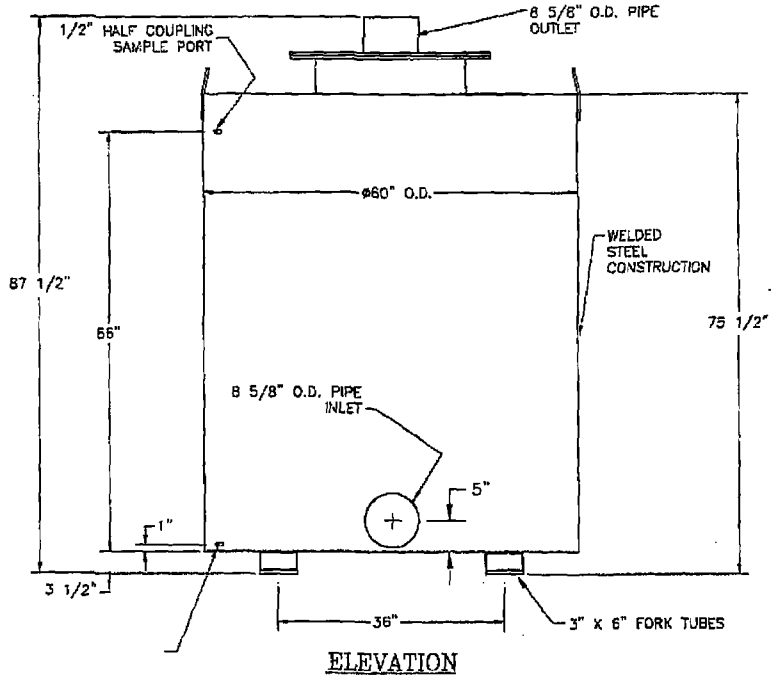
GRANULATED ACTIVATED CARBON VESSELS

CARBONAIR

Gas Phase Carbon Absorber Vessel GPC 20R



PLAN VIEW



ELEVATION

Vessel Specifications

Flow Range (cfm):	200 - 1800
Carbon Capacity (lb):	2000
Empty Weight (lb):	1200
Operating Weight (lb):	3200
Maximum Recommended Temperature (°F):	120
Minimum Temperature (°F):	34

Options

Hose Kits

Discharge Stack

Note: Actual dimensions and orientations may vary slightly than shown above.

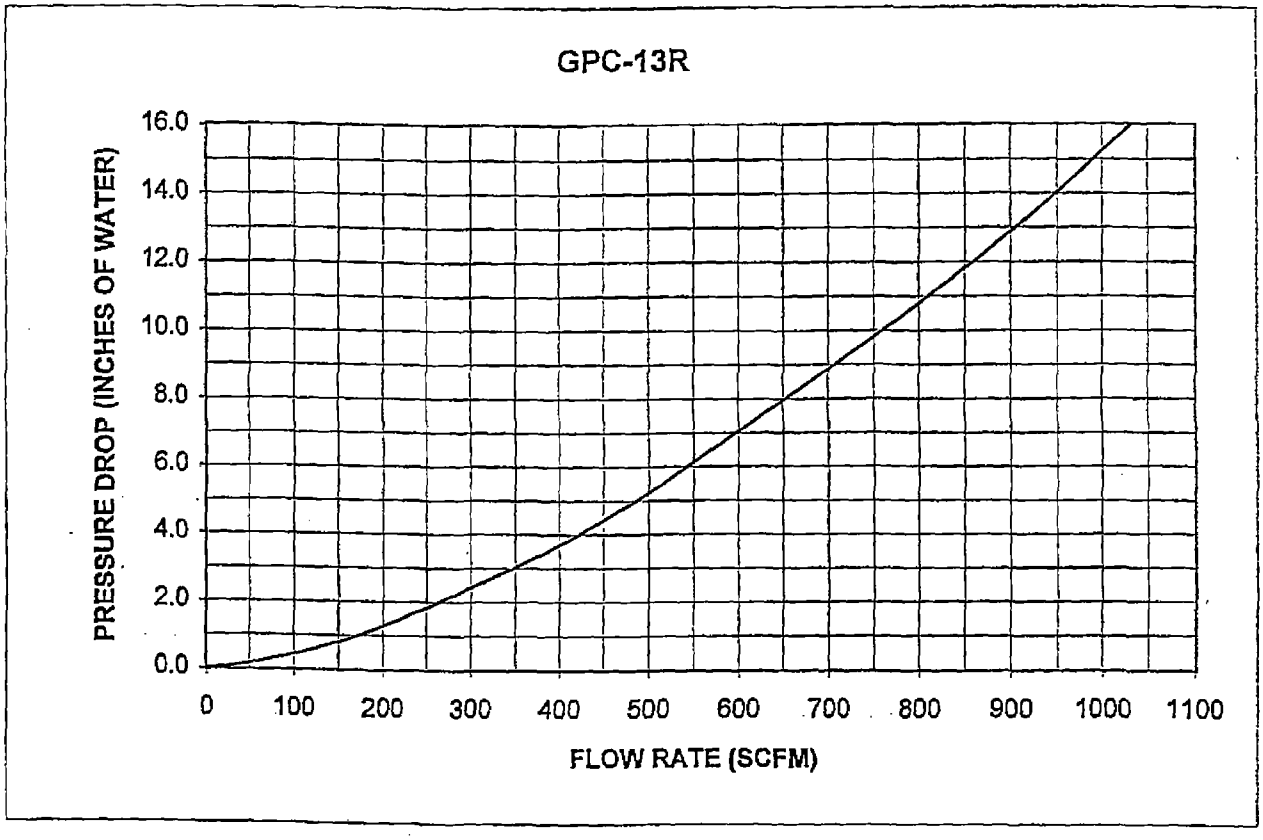
MINNESOTA: (corp hdqrtrs)
Carbonair
2731 Nevada Ave. N.
New Hope, MN 55427
PH:800.526.4999
763.544.2154
FAX:763.544.2151
Homepage: www.carbonair.com

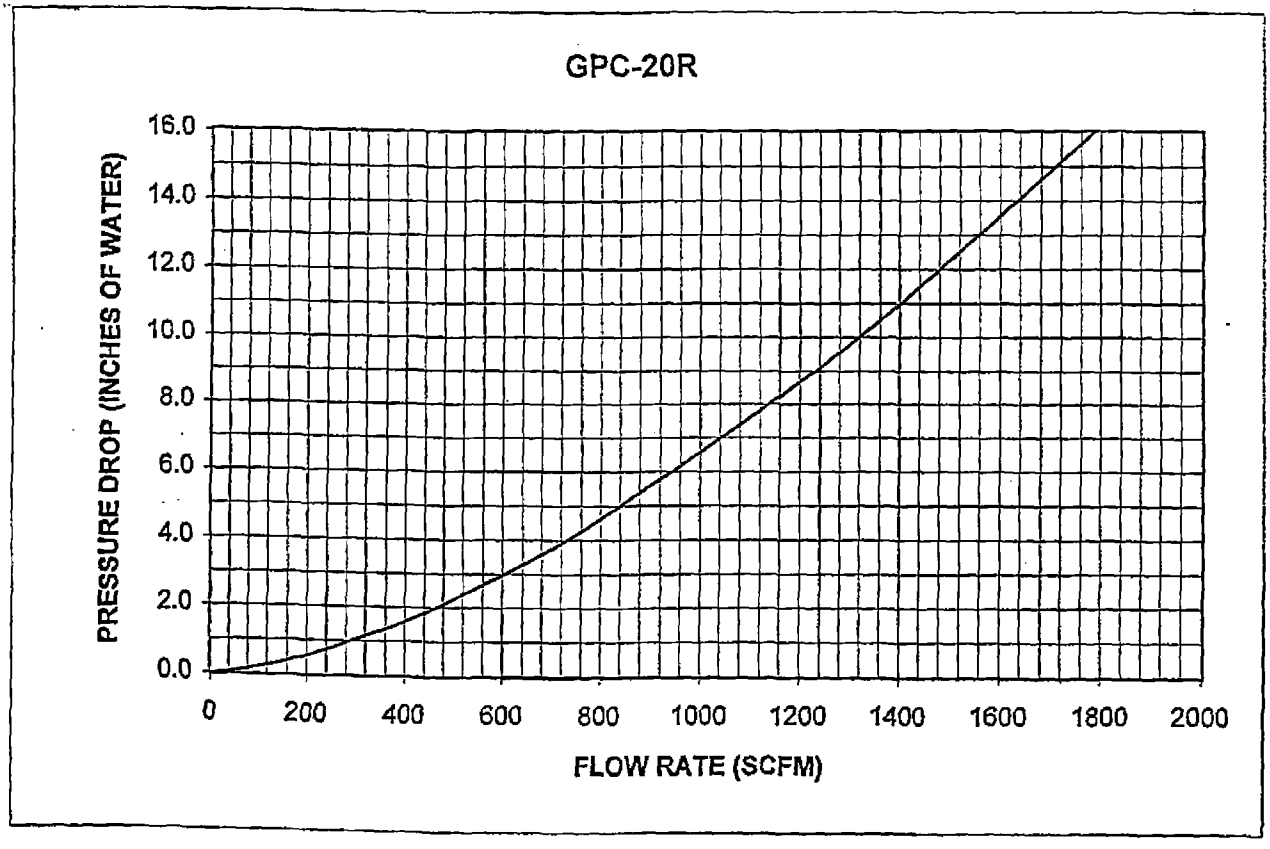
FLORIDA:
Carbonair
4710 Dignan Street
Jacksonville, FL 32254
PH:800.241.7833
904.387.4465
FAX:904.387.5058

VIRGINIA:
Carbonair
4328 West Main St.
Salem, VA 24153
PH:800.204.0324
540.380.5913
FAX:540.380.5920

TEXAS:
Carbonair
4889 Hunter Rd. Bldg 1-C
San Marcos, TX 78666
PH:800.893.5937
512.392.0085
FAX:512.392.0066

PRESSURE DROP THROUGH CARBONAIR GAS-PHASE UNITS



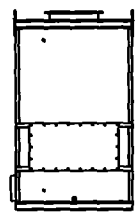


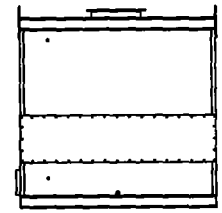
CARBONAIR
www.carbonair.com

GPC Series
Carbon Vessels

Carbonair's gas phase carbon absorbers are designed to provide an efficient and economical means to control odor, toxic vapors, and corrosive gases. Several types of activated carbons are available for a variety of applications.

Specifications*





Model	GPC 70	GPC 120
Flow Range (cfm)	700 - 7000	1200 - 12,000
Carbon Capacity (lb)	10,000	13,500
Vessel Diameter or Plot Size	**5'-0" x 16'-0"**	**8'-0" x 16'-6"**
Vessel Height	8'-5"	8'-6"
Bed Area (ft^2)	70	119
Empty Weight (lb)	5850	9250
Operating Weight (lb)	15,850	22,750
Influent Connection (NPS)**	**12 3/4" (2)**	**12 3/4" (2)**
Effluent Connection (NPS)**	**12 3/4" (2)**	**12 3/4" (2)**

Design Features

- **Welded steel construction**
- **Corrosion resistant acrylic polyurethane coated interior and exterior**
- **Steel grate and stainless steel screen**
- **Access port**

Options

- ☐ Influent/effluent sample and pressure taps
- ☐ Influent/effluent ducting
- ☐ Humidity control
- ☐ Discharge stack
- ☐ Blowers
- ☐ Complete line of granular activated carbon

Service Centers

FLORIDA
4710 Dignan Street
Jacksonville, FL 32254
800.241.7833
904.387.4465
904.387.5058 Fax

MINNESOTA
2731 Nevada Ave. No.
New Hope, MN 55427
800.526.4999
763.544.2154
763.544.2151 Fax

TEXAS
4889 Hunter Rd. Bldg 1-C
San Marcos, TX 78666
800.893.5937
512.392.0085
512.392.0066 Fax

VIRGINIA
4328 West Main Street
Salem, VA 24153
800.204.0324
540.380.5913
540.380.5920 Fax

*Specifications subject to change without notice.

APPENDIX B

Monthly Operation and Maintenance Checklist

SECOR

Monthly Operation and Maintenance Checklist

Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Date: _____
Personnel: _____

SVE Well Vacuum and Flow Readings

				Adjustments Made
SVE-1:	_____	in H_2O	_____ cfm	_____
SVE-2:	_____	in H_2O	_____ cfm	_____
SVE-3:	_____	in H_2O	_____ cfm	_____
SVE-4:	_____	in H_2O	_____ cfm	_____
SVE-5:	_____	in H_2O	_____ cfm	_____
SVE-6:	_____	in H_2O	_____ cfm	_____

Equipment Used/Notes: _____

_____

_____

AS Well Pressure and Flow Readings

				Adjustments Made
AS-1:	_____	psi	_____ cfm	_____
AS-2:	_____	psi	_____ cfm	_____
AS-3:	_____	psi	_____ cfm	_____
AS-4:	_____	psi	_____ cfm	_____
AS-5:	_____	psi	_____ cfm	_____
AS-6:	_____	psi	_____ cfm	_____
AS-7:	_____	psi	_____ cfm	_____
AS-8:	_____	psi	_____ cfm	_____
AS-9:	_____	psi	_____ cfm	_____
AS-10:	_____	psi	_____ cfm	_____
AS-11:	_____	psi	_____ cfm	_____
AS-12:	_____	psi	_____ cfm	_____
AS-13:	_____	psi	_____ cfm	_____
AS-14:	_____	psi	_____ cfm	_____

Equipment Used/Notes: _____

_____

_____

Blower

Total Flow Rate: _____ cfm
Blower Inlet Vacuum: _____ in. H_2O
Blower Temperature: _____ °F
Blower Hours: _____ hrs
Blower Inlet Filter Changed? YES or NO

Inlet Filter: _____
Amps: _____
Instrumentation: _____

_____

_____

SECOR

Monthly Operation and Maintenance Checklist

Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Date:_____
Personnel:_____

Compressor

Total Flow Rate: _____ cfm Amps: _____
Discharge Pressure: _____ psi
Compressor Temp: _____ °F
Compressor Hours: _____ hrs
Compressor Discharge Filter Changed? YES or NO
Equipment Used/Notes: _____

Vapor Treatment System

Carbon Influent Vapor Sample _____ ppm

Between Carbon Vapor Sample _____ ppm
Carbon Effluent Vapor Sample _____ ppm
Pressure After Secondary GAC Vessel: _____ psi
Primary GAC Vessal Replacement Required? YES or NO
Equipment Used/Notes: _____

System Piping and Fittings

Any leaks in Piping or Fittings? YES or NO
Equipment Used/Notes: _____

Extraction Well Vapor Sampling

SVE-1 _____ ppm
SVE-2 _____ ppm
SVE-3 _____ ppm
SVE-4 _____ ppm
SVE-5 _____ ppm
SVE-6 _____ ppm
Notes: _____

SECOR

Monthly Operation and Maintenance Checklist

Area 9/10 - Southeast Rockford Groundwater Contamination Superfund Site
Rockford, Illinois

Date:_____
Personnel:_____

Air/Water Separator

Flapper Valve Operational? YES or NO Level Probes Scaling YES or NO
Solids or Sludge in Separator? YES or NO
Notes: _____

Any Parts or Supplies to Order?

AS and SVE Well Inspection

Well ID	Well Casing Integrity (OK or Repairs Needed)	Integrity of Surface Seal? (OK or Repairs Needed)	Well Air Tight/Sealed? (YES or NO)	Wellhead Components? (OK or Repairs Needed)	Material Accumulation in well (To be Completed Quarterly)	Integrity Wellbox? (OK, Repairs Needed, or NA)	Pressure Vacuum Readings
SVE-1							
SVE-2							
SVE-3							
SVE-4							
SVE-5							
SVE-6							
AS-1							
AS-2							
AS-3							
AS-4							
AS-5							
AS-6							
AS-7							
AS-8							
AS-9							
AS-10							
AS-11							
AS-12							
AS-13							
AS-14							
AS-15							

Additional Notes: _____

_____ Signed Date

_____ Reviewed By Date

APPENDIX C

Completed Monthly Operation and Maintenance Checklist